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CARCINOMA OF THE OESOPHAGUS WITH SURVIVAL*

By E. E. Dunlop

Royal Melbourne Hospital

FOR approximately twenty years carcinoma of the oesophagus has been treated by energetic surgical measures.

The success by Adams and Phemister (1938) with bold trans-thoracic excision and oesophago-gastric anastomosis marked a turning point at which those undergoing the hazardous resections could at least look forward to restoration of alimentary continuity.

The occasional brilliant successes prior to this time were veritable lighthouses raised and lit by individual effort. Afterwards there emerged acceptable standard procedures to deal with every anatomical level of the gullet. Unfortunately, the problem continues to be most formidable, and workers in this field must still encounter much arduous failure and discouragement.

The tide of buoyant optimism has receded and some like Ravitch (1952) urge us to eschew "more and more extensive operations for more and more hopeless lesions", and to direct our efforts to palliation rather than to cure.

It is, therefore, time for those who have substantial case series at their disposal to subject their results to critical appraisal.

My own case series at this time is made up of 170 patients including every person who has sought treatment for carcinoma of the oesophagus in the period after the end of the Second World War in 1945 to August, 1959. As, however, it might be considered that some case selection is likely to be associated with a single surgeon, I have examined the histories of patients presenting with the disease at the Royal Melbourne Hospital over the ten-year period, 1949-1958. This latter series includes many of my own cases and a substantial number were treated with the cooperation of my colleagues, Mr. J. I. Hayward and Mr. Ian McConchie. Cases of these two surgeons and others are included.

Much confusion exists in the literature as to carcinomata of the cardia or upper stomach invading the oesophagus and carcinoma of the oesophagus itself.

Table 1

CARCINOMA OF OESOPHAGUS

Royal Melbourne Hospital (1949-1958)
Numbers and Average Age of Patients

Sex	*Number*	*Average Age*
Males	92	66
Females	46	65
Both sexes	138	65.5

In these series, cases with other than squamous-celled carcinomata have been included in only the very few instances where pathologists considered they were in truth oesophageal in origin.

It has not, however, been found practical to separate squamous-celled cancers involving both the pharynx and the oesophagus into two entities, and these are included as upper oesophagus. All deaths have been attributed

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to the carcinoma whether early or late though, of course, other causes of death operate in these frail elderly persons.

I am obliged to the Director of the Peter MacCallum Clinic for particulars of cases treated by radiotherapy over the same ten-year period. Some of these cases were referred by me, or have been seen in the capacity of Consultant Surgeon to the "Mouth and Throat" section of the clinic. Many of them received only palliative treatment and some were seen after failure of surgical treatment.

At the heart of our difficulties rests the age and frailty of the patients together with the formidable nature of the disease.

TABLE 2

CARCINOMA OF OESOPHAGUS

Royal Melbourne Hospital (1949-1958)

Average Age at Various Sites

Sex	*Lower third*	*Middle third*	*Upper third*	*All sites*
Male	60	69	69	66
Female	67	66	63	65

TABLE 3

METASTASIS

Royal Melbourne Hospital (1949-1958)

LYMPH NODES			
Involved nodes	75	68 per cent.	
No involvement noted	36	32 per cent.	
Involvement or otherwise not established	27		
BLOOD STREAM			
*Distant metastases	17	15 per cent. approximately of those reaching operative or post-mortem examination.	

*Organs involved included lungs 9, liver 7, suprarenals 3, kidneys 2, bone 2, thyroid 1, brain 1, heart wall 1.

Age and sex

The age of these patients has averaged 65.5 years in the Royal Melbourne Hospital series (Table 1) which approximates that in my own series in which patients have ranged from a young Tamil lady of 26 to two of 93 and 96 respectively.

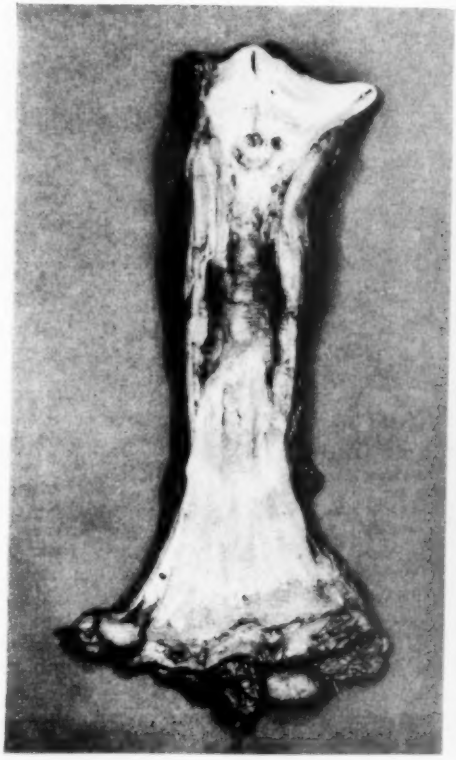

FIG. I. Photograph of resected specimen carcinoma of oesophagus in the middle third. The lymph nodes at the lower end were below the diaphragm on the left gastric artery.

In the British Empire Cancer Campaign report of 1942 the average was 65 years, and in the case records of Willis (1948) 67 years. There is little difference between the sexes though there appears to be a trend for the age of male patients to rise in years as the site of the lesion ascends in the oesophagus and for reversal of this process in females (Table 2).

Intractability

Carcinoma of the oesophagus classically runs a short course of relentless progressive dysphagia measured usually in weeks to a few months prior to sufferers seeking relief.

A long history is usually a measure of fortitude rather than benignity of the tumour and the outlook is usually poor in such cases.

It is to be regretted that there is little difference between the gravity of the findings at operation and those described by pathologists in those who have succumbed to their disease.

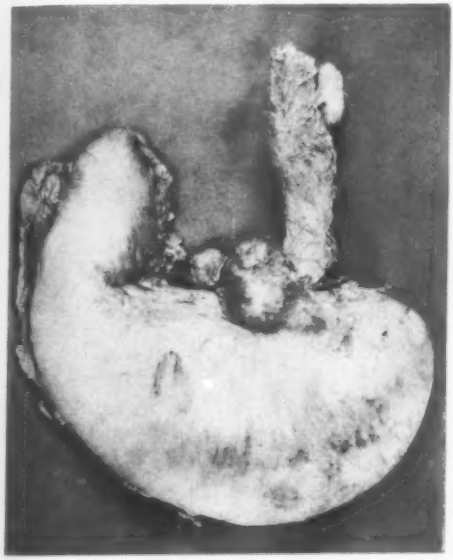

FIG. II. Photograph of resected specimen of oesophagus and stomach. The oesophageal carcinoma has metastasized to nodes on the lesser curvature of the stomach which have then invaded the gastric wall mimicking a second neoplasm.

In the Royal Melbourne Hospital series it was found that of 111 patients who could be assessed at operation or post-mortem, 68 per cent. had metastases, and no metastases were found in 32 per cent. (Table 3). This agrees fairly closely with Willis' (1948) autopsy figures of two-thirds with lymph node metastases. Seventeen patients in the same series had blood stream metastases demonstrated. The figure of 15 per cent. is probably minimal for the whole group (Table 3). Unfortunately, at least half of the patients without metastases presented with such extensive direct spread that removal of the entire tumour would be incompatible with life.

Those who aspire to success should note that tumours of the lower half of the oesophagus have a remarkable tendency to metastasize down below the diaphragm to the paracardial and left gastric groups of lymph nodes (Fig. I).

These nodes when involved may invade the stomach or other structures to form what appears like a second malignant lesion (Figs. II and III). This was noted in 7 of the Royal Melbourne Hospital cases.

Double carcinoma of the oesophagus was noted in five (Fig. IV). It is known that these appearances may be fallacious and continuity of malignant tissue below the surface epithelium may be present. In some cases,

FIG. III. Photograph of same specimen as Fig. II in section.

however, the whole oesophagus appears to have strikingly malignant potential. One was noted where the resection of an early mobile carcinoma with what is usually an adequate margin was followed by death two years later with two recurrent tumours above the anastomosis, and whilst lymph nodes were previously exonerated on section there were now widespread metastases.

In one of my cases in whom supra-aortic resection was carried out through a right abdomino-thoracic incision with division of the oesophagus 6 cm. above the growth in the contracted specimen, nevertheless local recurrence ultimately led to death (Fig. V).

In a lady of 70 with apparently a squamous-celled tumour of the lower third of the gullet, abdominal mobilization and

right thoracotomy revealed a long string of malignancy ascending inches up the oesophagus and associated with two small diverticula (Fig. VI). Supra-aortic anastomosis has enabled her to retain good health for over eight years.

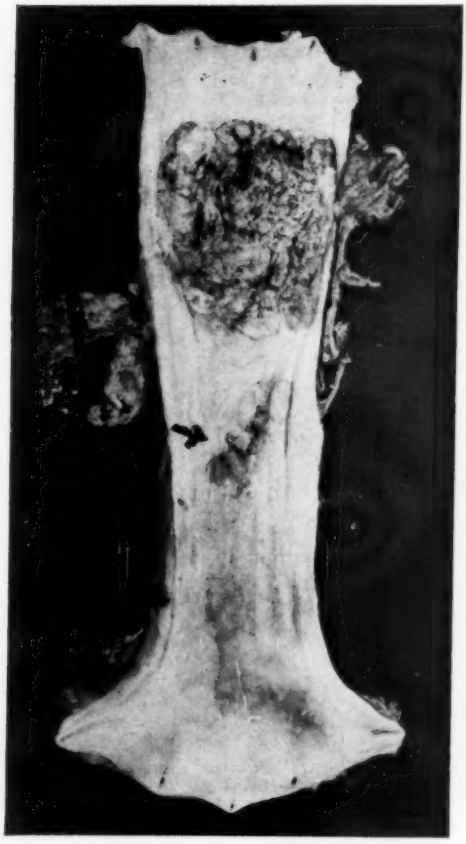

FIG. IV. Photograph of resected specimen of double carcinoma of the oesophagus. The lower smaller carcinoma indicated by the arrow.

The golden rule appears to be to approach the disease operatively as though the carcinoma were situated one third higher than it is.

All surgeons of experience have noted how the lesion appears to rise higher with mobilization of the oesophagus, so that the line of section may be too near the growth. In my opinion, supra-aortic anastomosis itself adds little to mortality, but much to survival. Cuff resections of the oesophagus have usually proved inadequate though in my personal series there are two long term successful resections of the cervical oesophagus conserving the larynx.

Operability

In a disease so fraught with hopeless suffering too much attention can be given to age and physical frailty.

FIG. V. Photograph of resected specimen of carcinoma of oesophagus. Recurrence in the oesophagus despite apparently adequate clearance.

In such cases we should ask ourselves whether there is any relatively simple palliative measure available. If decline and death can be made tolerable, in really bad risk patients no further measure may be contemplated.

Where no relatively simple method of restoring ability to swallow is available a case can be made for exploring all patients in whom there is no clinical indication that removal of involved structures will be incompatible with comfortable survival. Once,

however, exploration of the neck, chest or abdomen indicates incurable spread a prompt change to measures of intubation, or short circuit may be the wisest course. Operative manipulation may enable intubation to be done in cases where endoscopic efforts alone have failed.

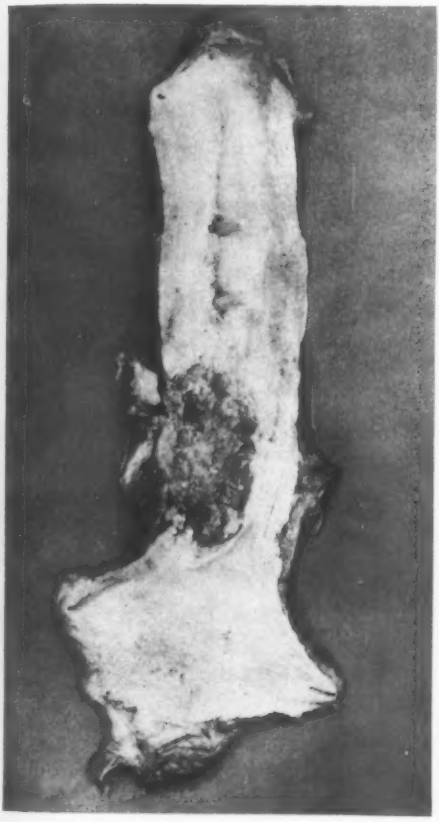

FIG. VI. Photograph of gross upward linear spread of carcinoma associated with two small diverticula marked with glass rods. Patient living in ninth year after supra-aortic anastomosis.

Oesophago-gastrostomy may be done using either the whole stomach, or a tube constructed on the greater curvature. The jejunum and right colon are popularly used for short circuits and the retrosternal tunnel (Ross Robertson) is highly recommended.

Those who reproach surgeons with the high mortality of resections should also take note of the appalling mortality of the disease itself (Table 6). With no treatment of 36 Royal Melbourne Hospital patients other than oesophagoscopy and dilatation (in most cases only medication), 41.6 per cent. died within a month, and of 33 with palliative procedures, mostly of quite minor nature, deaths within this period were 42.4 per cent.

TREATMENT

In the patients under consideration the treatment is summarized by the following tables 4, 5, 6. In the Royal Melbourne Hospital series it will be seen that half the patients underwent resections; roughly one quarter palliative surgery and one quarter only symptomatic treatment.

The rate of resection has been 68 per cent. in my own series.

TABLE 4

CARCINOMA OF OESOPHAGUS

Royal Melbourne Hospital (1949-1958)

Treatment		*Total patients*	*Per 100 patients*
*No operation (except dilatation		33	24 per cent.
Exploration only		3	2 per cent.
†Palliative operations:			
Short circuit	3		
Gastrostomy	11		
Jejunostomy	1		
Intubation	18	33	24 per cent.
Major excisions		69	50 per cent.

* X-ray therapy alone 8
† Tracheotomy 4

TABLE 5

PERSONAL SERIES

Total number of cases	170
Resection	116 — 68 per cent.
Operative mortality	33 — 28 per cent.

Palliative measures

(1) Intubation

Souttar's tubes have long enjoyed prominence, but personal experience would suggest

that they not infrequently pass onwards and they tend to become clogged with vegetable and other fibres.

Since 1950 considerable use has been made of plastic tubes (mainly Portex) of various sizes which can conveniently be made from intra-tracheal tubes of varied sizes which are given a well marked basal flange of acrylic or alternatively of soft plastic (Fig. VII).

In order to provide good swallowing these are for the most part too large to be passed even through the large Negus oesophagoscope. After dilatation a guide bougie is passed, the oesophagoscope withdrawn and the tube then threaded on the guide is chased by the oesophagoscope into position.

In the Royal Melbourne Hospital series it was carried out in 22 patients on 33 occasions and was a major palliative measure in 18. After almost equal use of Souttar's tubes and plastic tubes a preference for the latter has emerged.

There is very real risk of perforation in intubation. It may be a convenient retreating ground after exploration reveals a hopeless position.

(2) Gastrostomy and jejunostomy

These do not assist patients to swallow their stagnant secretions, and may prolong life a few months without relief of misery. It may be difficult to avoid them entirely in utterly intractable cancers when intubation is not successful.

TABLE 6

SURVIVAL

Royal Melbourne Hospital (1949-1958)

	Post -op.	Months					Years								
		0–1	1–3	3–6	6–9	9–12	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10
No operative treatment .. 36	— 41·6%	15	10	6	3	2									
Palliative operations .. 33	7 42·4%	7	9	3 1†	2 1†	2	1								
Major excisions 69*	23 33·3%		2	3	9 1†	5	13 1†	1 2†	1			1†	2†	1†	3†

* 1 Not traced.
† Living.

Tubes give most satisfaction about the central two fourths of the oesophagus. At the lower end insertion may be more difficult, and there may be troublesome regurgitation of gastric content.

In the upper third difficulties are encountered at times due to the tube causing irritation and oedema about the opening of the larynx. They may be well tolerated if embedded in malignant tissue.

The most satisfactory result seen has been prolongation of life in reasonable comfort for ten months in a frail old man of 81 with cardiac failure, and a cancer of the mid-thoracic oesophagus. Longer term results have been seen with external compression of the oesophagus by metastatic lymph nodes from breast cancer.

In such cases, for example palliative resection and replacement of the pharyngo-oesophagus with a skin graft carrying tube may be better and at the lower levels there is the possibility of short circuits using the stomach, jejunum, or colon. In complicated plastic reconstructive procedures a feeding opening may be a preliminary measure and it may become necessary post-operatively because of a leak from the anastomosis.

In the Royal Melbourne Hospital series (Table 4) palliative gastrostomy was performed on 11 occasions and jejunostomy on 1. There was a pre-operative gastrostomy in 6, post-operative in 4 and post-operative jejunostomy in 3.

(3) Short circuits

These have been carried out on 3 occasions in the Royal Melbourne Hospital series (Table

4), oesophago-gastrostomy (Tanner) and oesophago-jejunostomy via the retrosternal tunnel (Ross Robertson).

My own series includes gastro-oesophagostomy in 3 and oesophago- or pharyngo-jejunostomy in 6. Three patients of the 9 died in the post-operative period.

FIG. VII. Photograph of plastic tubes for intubation. The larger tube is employed for pharyngeal replacement.

The right colon has not been employed in either series. It would seem preferable to employ short circuits in preference to quite inadequate resections.

(4) Palliative resection

Very often this becomes necessary because the point of no return is reached in preliminary dissection. The diseased oesophagus or air passage may be breached necessitating the surgeon to "battle on".

There is occasional encouragement from the circumstances that resections regarded as utterly palliative may be followed by long survival of patients. For example a male patient with an adherent carcinoma involving both the lower and middle thirds had also massive lymph nodes about the hilum of the left lung, and below the diaphragm (Fig. VIII). Resection has been followed by survival without obvious recurrence for 9 years and 9 months to date. In general, however, we must resist the temptation to extend resections to cases beyond their scope.

FIG. VIII. Photograph of resected specimen of seemingly quite intractable carcinoma of oesophagus. The heavy metastasis to sub-diaphragmatic glands is in evidence. Patient still surviving in his tenth post-operative year.

X-ray therapy

A definite increase of life has been apparent. The average time a patient survived after therapy was about seven months in 32 cases so treated at the Peter MacCallum Clinic 1948-1958. It would seem, however, that the dysphagia may not be relieved very promptly and in some cases not at all so that preliminary intubation should be done where possible. There may be a serious pay-off of

irradiation disorders and pulmonary fibrosis. Curative or radical X-ray therapy is preferred by many for the upper third of the oesophagus and by some for the middle third.

No long term survival has been seen at the Peter MacCallum Clinic except that in two cases local recurrence after surgery treated by X-ray therapy has been associated with survival which continues in one case to the fifth year and another one year and ten months.

Perhaps in the future judicious combinations of surgery and radiotherapy and more accurate delineation of the area to be treated by radiotherapists may lead to some improvement.

TABLE 7

FIVE YEAR SURVIVAL

Personal Series

Seen before five years ago	91	
Resected before five years ago	68 — 76	per cent.
*Survived five years	18 — 20	per cent. of all cases seen.
	26	per cent. of resections.
*Still living (five to ten years)	14	

Major surgical excisions

In the writer's opinion the operative approach should vary considerably with the level of the growth.

In the lower third of the oesophagus the preference has been for a very big left thoraco-abdominal incision. Usually the anastomosis is then performed below the aortic arch, but in the event of the Garlock transposition being necessary this does not give much difficulty so long as the aortic arch area is clear of malignancy.

In the middle third lesions the separate abdominal and right thoracic approach of Ivor Lewis is highly recommended. There may be the objection that the abdominal phase of the operation involving mobilization of the stomach and dissection of lymph nodes below the diaphragm is carried out before resectability is ascertained. There is, however, a superb and unimpeded approach to the whole thoracic oesophagus once the slender barrier of the azygos vein is divided and for intractable cases the procedure can be terminated by short circuit of the stomach to oesophagus above the tumour.

The right abdomino-thoracic incision has been used in a few cases usually those which do not rise much above the lower third. The mobilization of the stomach may be more difficult in this position but it has the merit of permitting two workers to proceed simultaneously.

The upper third of the oesophagus though conquered first by Czerny (1877) requires the most ingenuity and a fascinating variety of procedures have been devised.

TABLE 8

SURVIVORS OVER THREE YEARS

Personal Series

Lower third	8
Middle third	8
Upper third	4
Total	20
Metastasis to lymph nodes	7

In the case of cancers which involve the pharyngo-oesophagus or cervical oesophagus alone, in a very few it is possible to do a conservative pharyngo-oesophagectomy with either primary suture or second stage skin reconstruction leaving the larynx to voice the gratitude of the patient.

Usually, however, the operation is pharyngo-oesophago-laryngectomy with either the staged type of buried skin tube reconstruction popularized by Wookey (1948) or replacement by a skin graft bearing plastic tube. These split skin grafts do not provide much protection against stricture after removal of the splinting tube. Even after leaving such a tube in situ for six years there has been some mild tendency to contracture after its removal.

Thus in general full thickness skin reconstruction is preferred for those whose chances of cure appear to be good, but if they are

doubtfully curable the skin grafted "former" is inserted and the neck closed over it with the expectation that the patient will have the ability to swallow and leave hospital in about two weeks.

Nothing could be more depressing than recurrence preventing the completion of neck reconstruction. Usually this can be completed in eight to ten weeks.

Cervico-dorsal cancers which extend from chest to neck or vice versa present the most formidable problems. The writer has only seen two such males in cancers in this region in which lymph nodes were not involved and for the most part the patients have been beyond the likely scope of any form of therapy.

TABLE 9

RESULTS OF TREATMENT OF CARCINOMA OF THE OESOPHAGUS IN CENTRES REPORTING ALL PATIENTS SEEN* (MOSS, 1959)

Author, Hospital and City	*Years*	*Total No. Patients Seen*	*Per cent Treated by Surgery*	*Per cent Treated by Irradiation*	*No. Surviving 2 Yr.*	*No. Surviving 5 Yr.*	*Treatment of Survivors†*
Watson and Goodner Memorial Hospital New York	1931–1955	1,253	11·1	64·7	34	12	S, 3 R, 6 R–S, 3
Smithers Royal Marsden Hospital London	1936–1951	314	6·4	72·9	21	10	R, 9 S, 1
Vol. 1, Annual Cancer Report 1953 United Hospitals Birmingham	1936–1951	703	17·4	40·5	13	2	S, 2
Garlock and Klein Mount Sinai Hospital New York	1936–1952	457	42·9	0·0	27	11	S, 11
Puestow, Gillesby and Guynn Veterans' Administration Hospital Hines, Ill.	1939–1954	489	13·3	49·7	6	—	
Third Statistical Report of Holt Radium Institute, 1950 Christie Hospital & Holt Radium Institute Manchester	1940–1944	260	0·0	54·6	—	—	
Hultberg Radiumhemmet Stockholm	1940–1950	691	0·3	58·9	18	10	R, 10
Buschket Swedish Hospital Seattle	1940–1950	59	0·0	52·5	—	3	R, 3
Shedd, Crowley and Lindskog Yale University School of Medicine New Haven	1940–1950	180	16·7	23·3	—	3	S, 3
Parker, Hanna and Postlethwaite Roper Hospital Charleston	1940–1951	170	17·7	4·1	1	—	
Tanner St. James' Hospital London	1944–1951	160	41·9	0·0	16	6	S, 6
Ebenius and Gynning Radiotherapy Department University Hospital London	1944–1952	249	0·0	86·7	28	12	R, 12
Adams and associates Lahey Clinic Boston	1945–1949	161	42·9	0·0	20	3	S, 3
Nakayama Chiba University School of Medicine Chiba	1946–1953	1,202	31·1	—	94	18	S, 18

* Modified from Smithers (1957).
† R, radiation; S, surgery (resection).

They are treated for the most part by procedures involving the neck, chest and abdomen. Sternum-splitting procedures give rather limited approach to the thoracic oesophagus.

The retrosternal route to the neck is a simple pathway for jejunum or colon, but in my view is of greatest use in cases in which resection is regarded as impracticable.

The favourite practice has been to operate with the patient on the back and with neck, chest and abdomen prepared. Incisions are made in the right side of the neck, right antero-lateral thoracotomy (resecting the 3rd or 4th rib and costal cartilage and dividing costal cartilages as necessary), also the abdomen.

The mobilized stomach is handed from abdomen to chest and chest to neck. The patient is tilted as required, but no major change in position is necessary.

As was the case with nearly all surgeons who have had much experience with these operations, it was soon realized that with divided vagus nerves gastric emptying must be aided by pyloroplasty, or Ramstedt-like procedures, and in any case the indwelling aspiration tube is best passed through the anastomosis to the stomach.

SURVIVAL

In discussing survival it will be apparent that the small band who survive the hazards to be reprieved for a relatively long time rest upon a large pyramid of those who fall out relatively early. At the end of life, however, an extra year or two may have a disproportionate value to the individual.

A high oesophago-gastric anastomosis and some of these more complicated reconstructions are compatible with comfortable survival and digestive efficiency. Some of these patients have regained most active pursuits.

As in most series of any size there has been one patient of whom it could be said "before treatment he could not swallow, but he could eat, afterwards he could swallow but could not eat".

The survival of patients in the Royal Melbourne Hospital series (Table 6) indicates a worthwhile long term salvage of 7 five-year survivors, and striking evidence of palliation in the group of 13 cases who succumbed in the second post-operative year.

The excellent summary of world results by Smithers (1957) which has more recently been modified and restated by Moss (1959) is shown (Table 9). It is somewhat surprising to note that from all these large case series collected round the globe only 90 five-year survivors are recorded in this table of which 50 were surgical successes and of these 18 were claimed by Nakayama of Japan.

Mustard and Ibberson (1956) recorded 381 patients at Toronto, of which 8 (3 per cent.) survived five years.

Postlethwaite and his co-workers (1957) detailed 253 patients with 5 (4.1 per cent.) surviving five years. The overall mortality was 25 per cent. and 40 per cent. in the middle third.

Garlock and Klein (1954) recorded 12 patients with lower third growths, and four with middle and upper third lesions who had reached five year survival. Their initial operative mortality was one in three.

Adams (1955) of the Lahey Clinic has published an uplifting surgical record of 89 patients with 35 resections of which no less than 9 lived five years or more.

Smithers (1957) record of 314 patients at the Royal Marsden Hospital had 10 (3 per cent) five year survival of which 9 were treated with radiotherapy.

Sweet (1954) records 17.5 per cent. five year survival of those undergoing resections for lower third tumours but only 4 per cent. of middle third resection survived that period after an initial 25 per cent. mortality.

Nakayama (1954) submits the unique record of 399 resections in which his mortality for 285 cases of lower third and cardia cancer resection was 5.3 per cent. and 84 in the middle and upper thirds with 13.8 per cent. mortality. Reference has already been made to his 18 five year survivals.

My own case series now embraces 170 patients (Table 5) in whom resections were carried out in 116 (68 per cent.) with 33 post-operative deaths (29 per cent.). Mortality was 15 per cent. lower third, and 32.5 per cent. in middle and upper third cases.

In the resected cases the site distribution has been lower third 33, middle third 44 and upper third 39 respectively.

Five year survivors can as yet be related only to 91 patients (Table 7) of which 68 submitted to resection with 18 five year survivals of which 14 are still living at five to ten years.

There have been 20 survivors beyond three years of which 8 were lower third, 8 middle third and 4 upper third respectively (Table 7).

In terms of these results, of 100 sufferers 68 undergo a resection of which 28 die in hospital and of 40 survivors 20 go on past the five year term.

SUMMARY

1. Some modern trends in the treatment of carcinoma of the oesophagus are discussed.

2. A personal case series of 170 patients with carcinoma of the oesophagus during the period 1945 to 1959 and a ten year series from the Royal Melbourne Hospital (1949-1958) are presented.

Carcinoma arising in the stomach or gastric cardia are excluded but not those involving both pharynx and oesophagus.

Brief reference is made to 32 cases who received radiotherapy at the Peter MacCallum Clinic over the same period 1949 to 1958.

3. The advanced age and frailty of the patients are evidenced, and sex variations discussed in relationship to site.

4. The intractability of many of the lesions is discussed in terms of local metastasis (68 per cent.), blood stream metastasis (15 per cent.) and advanced spread. Reference is made to double carcinoma and vagaries of spread and recurrence. A wide margin of resection is advised if cure be the objective.

5. Views on the place of palliative and radical procedures are advanced in the light of the pathology, the distress of the patients and the grim outlook of the untreated disease.

6. Palliative measures discussed include intubation (with preference for plastic tubes), gastrostomy and jejunostomy (which are not favoured), short circuits, palliative resection and X-ray therapy.

7. Major surgical excisions were carried out in 68 of the personal case series; lower third 33, middle third 44 and upper third 39 with mortality 29 per cent. (15 per cent. lower third, 32.5 per cent. for the upper two-thirds).

8. On the basis of results obtained in Melbourne there does not appear to be any well-established case for abandoning surgery for carcinomata of the upper two-thirds of the oesophagus.

9. A survey of these results together with others available from other countries suggests that the disease is grim indeed, but that surgery offers comfort and some distinct hope of lasting relief.

ACKNOWLEDGEMENTS

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CARCINOMA OF THE PHARYNX*

By N. C. Newton

Sydney

TWENTY years ago, Wilfred Trotter (1939) made the following statement: "The improvement in the treatment of cancer to its present fairly respectable level has been unfortunately far from uniform for all types of the disease. Thus, while in certain situations early cases can now be regarded as normally curable, there are certain other situations in which cancer retains its sinister reputation undiminished. One of these is the pharynx, and there can be no doubt that, if we judge by the results now being obtained throughout the world in the treatment of cancer of the pharynx, we must agree that the disease thoroughly deserves its evil name." Surely this statement is equally accurate today.

The following paper is based on an analysis of cases seen at St. Vincent's Hospital and in the practice of the author over a period of the last six years. The number of cases is small in comparison with most other published works but in all probability compares with the experiences of most general surgeons in this country interested in this field of surgery.

The term pharynx is used here to include the pyriform fossa and the hypopharynx.

Although cancer in this region is notoriously malignant, it is important that it be recognized and referred for consideration at the earliest possible moment. This can best be helped by realization that the early symptoms of cancer in this region are trivial in nature and that it is ignorance of the significance of these early symptoms which is responsible for the large percentage of cases which, when first seen, present the overwhelming symptoms of severe dysphagia, dyspnoea and continual pain, which in many cases herald the early demise of the patient.

*Received for publication 21st September, 1959.

Symptoms

The earliest symptoms constitute no more than a mere persistent abnormal sensation in the throat variously described as "sore throat," "a tickle," "a feeling of a lump," or a little "pain on swallowing." The patient can always locate the sensation to a definite part of the throat and it is persistent. Later symptoms such as hoarseness, dyspnoea, dysphagia and the appearance of a lump in the neck need no stressing.

Diagnosis

The realization of the significance of these symptoms must necessarily be followed by an adequate clinical examination both of the pharynx and the neck. This necessitates the use of a laryngeal mirror for the performance of indirect laryngoscopy. The performance of this simple examination is in no way the prerogative of the specialist nor, for the purpose for which we are concerned, does it require special skill. Indirect laryngoscopy will permit the clinician to detect:

(1) An ulcer or tumour;

(2) swelling of the arytenoids;

(3) alteration in the mobility of the vocal cord;

(4) abnormal accumulation of mucus or muco-pus in either the pyriform fossa or the hypopharynx.

Any such abnormal finding is sufficient to warrant referring such a patient to a specialist competent to deal further with the possibilities which may arise.

Investigations

In addition to adequate examination of the pharynx and careful palpation of the glandular areas of the neck, radiological investigation can give a wealth of information. Soft-tissue films will often give more information than a barium swallow; the pharynx and upper oesophagus being notoriously difficult to examine by barium contrast, owing to the rapidity with which the bolus traverses this

area. Lateral films will often show not only the presence of the lesion but will give a good assessment of its longitudinal extent; information which is most difficult to obtain otherwise and which is most important when determining a plan of treatment (Figs. I and II).

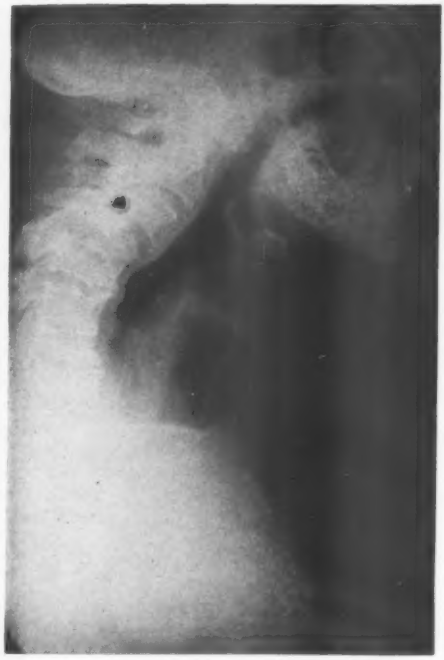

FIG. I. Soft tissue X-ray showing post-cricoid carcinoma.

Failure to appreciate this longitudinal extent led to a most costly error in dealing with Case 1, described hereafter.

Direct examination by endoscopy of the pharynx, larynx, oesophagus and trachea is also essential. It is important to realize that neglect of examination of the trachea may lead to failure to recognize its involvement in the spread of the disease.

The significance of an immobile vocal cord in these cases needs stressing, for its presence indicates either direct involvement of the arytenoid which is easily seen, or actual recurrent nerve involvement by spread of the lesion through the pharynx into the region of the lateral lobe of the thyroid. This knowledge is important in planning a surgical attack.

CARCINOMA OF THE PYRIFORM FOSSA

This group contained 14 cases — 12 of whom were males and 2 females. The average age of the patients was 70 years, the youngest being 50 and the eldest 83 years.

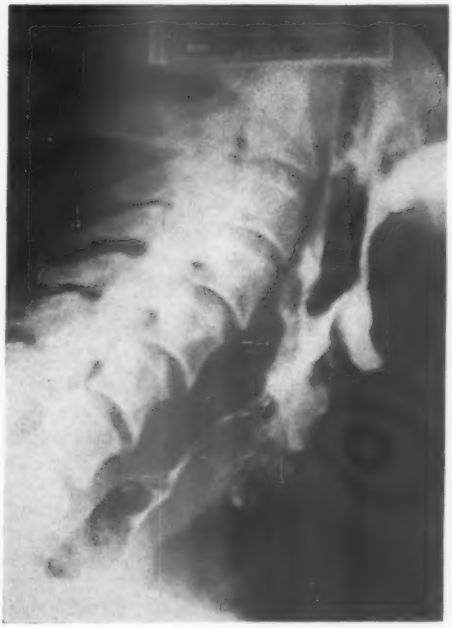

FIG. II. Barium swallow X-ray showing extensive hypopharyngeal carcinoma. Upward extension as far as C.3, downward extension as far as C.7 (Case 7).

All were managed by irradiation without surgery and the results of this were far from satisfactory. Twelve of the 14 are dead, the longest survival being twenty months from the time of diagnosis. Two patients are yet alive, nine months and six month respectively.

Although 10 of the 14 cases reviewed would be considered to be hopeless when first seen, it is indeed a sorry story, especially when one considers that Pilcher (1948), reviewing Trotter's cases operated on before 1935, was able to show that of 100 cases, 49 were

judged operable and although there had been 16 operative deaths, 7 of the survivors had lived five years or more without recurrence.

It is true that the majority of our cases were unsuitable for operation, especially of the conservative type of lateral pharyngotomy devised and practised by Trotter, however, with modern surgical aids such as better methods of anaesthesia and resuscitation and with control of infection by antibiotics along with better pre-and post-operative care, it should be possible to extend the range of radical surgery to include this region of the pharynx. Indeed surgeons such as Martin (1954) and Conley (1959) are adopting this method for some of their cases. However, despite these surgical advances, a large number of cases will continue to be seen in an inoperable state and will be suitable for no more than palliative X-ray therapy.

CARCINOMA OF THE HYPOPHARYNX

Carcinoma in this situation, like that of the pyriform fossa, is a major problem not only of diagnosis but of treatment.

We have accepted surgery as the treatment of choice for hypopharyngeal lesions and use radiation only as a palliative procedure for those whose lesion is obviously beyond surgical clearance.

Surgical approach to these lesions creates 3 separate problems: the extent of local resection, the management of the glandular area and the method of reconstruction.

We believe that the extent of local resection should involve a total removal of the larynx as well as the affected pharynx and the upper oesophagus and we have not endeavoured to conserve the larynx, believing that this seldom conserves the patient but always conserves the disease.

In the past it has been our practice in the absence of clinical glandular enlargement to observe the glandular areas, performing neck dissection only if and when glands become clinically involved. If clinically involved glands were present on one side at the time of the initial operation, we have performed gland dissection on that side together with laryngopharyngectomy, keeping the other side of the neck under observation and performing dissection if and when clinical glandular involvement becomes apparent. This policy has not proved a satisfactory one and review of our experiences suggests that it would give a better chance of cure if the glands are resected at the time of the original operation. Only 2 of our cases and those small lesions, have not developed glandular metastases.

FIG. III. Case 2: Photograph showing patient at time of performance of operation for closure of the lateral sulcus formed at the first stage of the Wookey operation.

Our initial approach to reconstruction was the use of the operation devised by Trotter, modified and popularized by Wookey (1948).

This is in many ways a satisfactory operation and has been used on 5 of the 7 cases upon whom we have operated. It has however serious disadvantages. (a) It is a staged procedure requiring 3 separate operations for its completion, the patient therefore spending what may well be a very large portion of

their residual life in hospital. This is particularly so if any sloughing skin causes delay between stages. (b) Thorough gland dissection, which we now feel to be wise, is not practical at the time of the first stage of the Wookey operation, as extensive mobilization of skin flap jeopardizes its blood supply, and may well interfere markedly with the reconstructive phase of the operation. We therefore feel, that it is probably suitable only for very early lesions and even in such cases, a better chance of a permanent cure would be achieved by other methods. (c) In the male, the growth of hair in the skin-lined pharynx has proved an unpleasant and troublesome sequel.

Another method we have used to reconstitute swallowing in a one-stage operation, is the utilization of the stomach after a method described by Jack (1955). The stomach is mobilized from the abdomen leaving its blood supply from the right gastric and right gastro-epiploic vessels. It is brought up through the lower end of the skin tube where it joins the oesophagus. This complication of stricture occurred in the only case in which we have used this method of reconstruction and was eventually a factor in the patient's demise. Conley (1959) advised the retention of a prosthesis for six months in order to prevent this complication.

TABLE 1

Case	*Sex*	*Age*	*Treatment*	*Result*	*Survival*
1	M	54	Wookey operation — 1st stage	Died of disease	5/12 years
2	F	53	Wookey operation	Alive and well	6 years
3	M	67	Wookey operation	Alive and well	4·6/12 years
4	M	52	1. Wookey operation and right neck dissection 2. Left neck dissection	Died of disease	3 years
5	F	63	Wookey operation and right neck dissection	Alive and well	3 years
6	M	40	Radiotherapy and Souttars tube	Died of disease	9/12 years
7	M	79	Cobalt 60	Died of disease	5/12 years
8	F	64	1. Pharyngo - laryngectomy with "sleeve graft" reconstruction 2. Right neck dissection	Died without recurrence	2 years
9	F	74	1. Laryngo - pharyngectomy and replacement of pharynx with stomach 2. Right neck dissection	Alive and well	9/12 years

The concept of replacing the pharynx in a one-stage operation has exercised the minds of surgeons for a long time and earlier methods were followed by a high rate of complications. However, more recently the use of a thick dermatome graft over a prosthesis has been successful in a high proportion of cases (Shaw and Omerod, 1957). The major disadvantages appear to be the development of fistulae or stricture at the oesophageal hiatus into the chest and after mobilization of the oesophagus, is brought into the root of the neck and anastomosed to the base of the tongue and pharynx, after excision of the larynx and pharynx. This method was used in Case 8 primarily because the lesion in this patient extended down the cervical oesophagus into the upper reaches of the mediastinum and it was felt that the other methods described could not be applied in this situation.

This operation proved a most satisfactory one-stage performance and despite the patient's 74 years, she tolerated laparotomy, thoracotomy and cervical operation without complications.

Our experiences in this field are limited to 9 cases, 5 of whom are males and 4 females. Their average age is 60.6 years, the youngest being 40 and the eldest 79 years. The age and sex incidence and results of these nine cases are in Table 1.

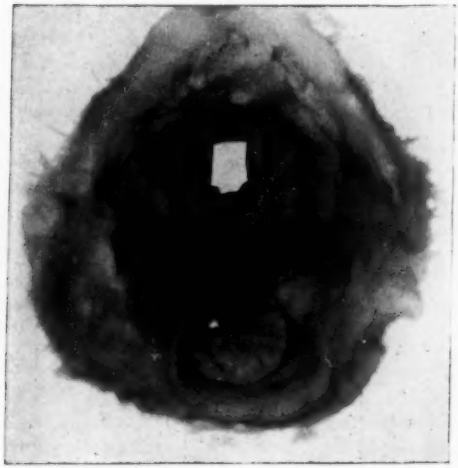

FIG. IV. Case 2: Photograph of specimen showing lesion on the posterior and right lateral walls of the hypopharynx.

Two of these patients were hopelessly inoperable when first seen and had palliative X-ray therapy, surviving only five and nine months respectively. One patient was wrongly assessed as operable and developed an obvious growth at the root of the neck in the region of the oesophageal stoma before the last stage of the Wookey operation could be performed. He died five months after the initial operation.

CASE REPORTS

Case 1

Male, aged 54 years, first seen February, 1953, with a twelve months' history of dysphagia for which he had consulted several doctors. He had on two occasion had barium studies performed with negative results. His dysphagia had increased markedly and when first seen here could swallow only liquids. Indirect laryngoscopy revealed a fungating tumour in the post-cricoid region, which on direct examination appeared to surround the whole circumference of the oesophagus. The larynx was normal but bronchoscopy was not performed. There were no palpable cervical glands. Biopsy showed grade III squamous carcinoma.

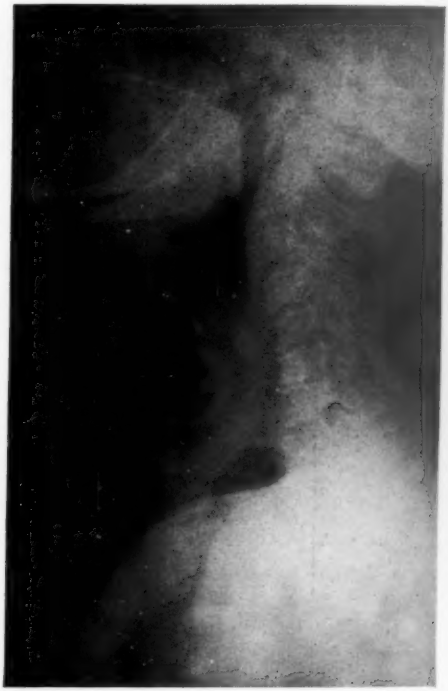

FIG. V. Case 8: Soft tissue X-ray lateral view, showing extent of the post-cricoid tumour.

In March, 1935, the first stage of a Wookey operation was undertaken and the lower extent of the lesion was much greater than it first appeared. It was with difficulty that the resection was carried into the beginning of the thoracic oesophagus. There was sloughing of the skin flap, which prevented any attempt at the second stage of the operation for nearly two months. By this time, nodular thickening around the oesophagostome heralded recurrence, which continued to grow at a surprising rate. No further operation was performed and the patient died five months after the original operative intervention.

Case 2

Female, aged 53 years, first seen July, 1953, complaining of dysphagia all her life, which had increased markedly in the previous three months. She was found to have carcinoma in the hypopharynx, extending across the posterior wall and into the right lateral wall. Biopsy showed grade II squamous carcinoma. The vocal cords and trachea were normal and there was no cervical node involvement.

In August, 1953, a Wookey operation was performed, the third stage was not completed for two months. This patient has remained well and free of any recurrence to the present time (Figs. III and IV).

FIG. VI. Case 8: Barium swallow, lateral view, showing post-cricoid lesion outlined clearly by barium.

Case 3

Male, aged 67 years, first seen January, 1955, with a six months' history of a "feeling of something in his throat" on the left side and some dysphagia. Investigation showed a lesion extending from the hypopharynx upwards into the left pyriform fossa. There was oedema of the arytenoid, but cord movement was normal. The cervical glands were clinically normal. Biopsy showed a squamous carcinoma of moderate malignancy.

Laryngo-pharyngectomy was carried out by the Wookey procedure and various difficulties with the skin flaps delayed final closure for almost six months. This patient demains well to the present time.

Case 4

Male, aged 52 years, first seen September, 1955, with a history of soreness of the throat localized and persistent, and mild dysphagia for four months. He had been treated for anaemia for twelve months.

On examination the patient had a lesion of the hypopharynx extending across the posterior wall and into the right lateral wall, with no involvement of the cords, larynx or trachea. The glandular areas were clinically clear.

In November, 1955, a laryngo-pharyngectomy and block dissection of the lower half of the right side of the neck was performed, the pharynx being reconstituted by the Wookey method. The patient remained well until September, 1956, when he presented with a gland in the left side of the neck and he underwent left neck dissection. He remained well following this, apart from three episodes in which hair in the reconstituted pharynx caused trouble and required trimming. In August, 1958, the patient developed a mass in the upper right mediastinum for which he had some deep X-ray therapy. In November, 1958, he developed "pneumonia" and X-ray at this time showed gross invasion of his mediastinum and the right upper zone. He died within a week of the onset of this chest complication.

FIG. VII. Case 8: Photograph of resected specimen showing lesion occupying post-cricoid region.

Case 5

Female, aged 63 years, first seen June, 1956, with a long history of dysphagia for which she had seen many doctors over many years. For twelve months prior to consultation she had had increasing dysphagia and had reached the stage of being only able to take semi-solid or liquid foods. There was a gland palpable in the lower right side of the neck.

Indirect laryngoscopy revealed a tell-tale pool of muco-pus in the hypopharynx and X-ray revealed a filling defect in the post-cricoid and upper cervical oesophagus. Direct laryngoscopy confirmed a post-cricoid carcinoma and showed no invasion of larynx or trachea. Biopsy showed a grade II squamous carcinoma.

On 22nd June, 1965, laryngo-pharyngectomy and dissection of the lower half of the deep cervical chain on the right side was carried out, combined with the first stage of the Wookey operation. The final stage of the operation was completed in 8 weeks. Examination of the specimen showed a small and localized lesion of the posterior wall, extending around to the right lateral wall. The glands removed were positive for metastatic growth.

This patient remains free of disease but is under medical treatment for attacks of congestive cardiac failure.

FIG. VIII. Case 8: Barium swallow, oblique view, showing adequate lumen in new skin-lined oesophagus, two and one-half weeks after operation.

Case 6

Male, aged 40 years, first seen October, 1957, with a history of rapidly increasing dysphagia of six weeks' duration. On examination the patient had large hard glands at the root of the neck on both sides. There was a large growth filling the lumen of the hypopharynx at the junction of the pharynx and oesophagus. Soft tissue films showed the lesion extending upwards into the pharynx down to the level of the 7th cervical vertebrae and suggested invasion of the posterior tracheal wall.

Direct examination confirmed these findings and a poorly differentiated squamous carcinoma was found on biopsy. The patient was considered inoperable and was treated by X-ray therapy. He got very little relief from this, his dysphagia becoming worse and he required dilatation and insertion of a Souttar tube. He died nine months following diagnosis.

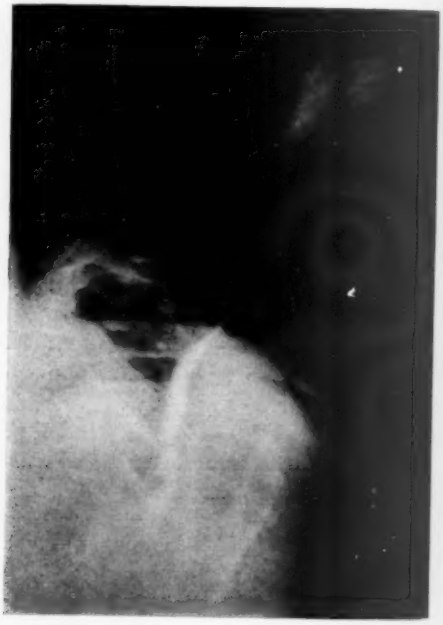

FIG. IX. Case 8: Barium swallow, oblique view, showing marked stricture formation in lower half of the skin tube.

Case 7

Male, aged 79 years, first seen in April, 1958, complaining of soreness of the left side of the throat, sticking of foods in this area and hoarseness for one month. The symptoms had progressed rapidly and at the time he was first seen he had difficulty swallowing even fluids and had lost one and a half stone in weight.

Examination revealed a tumour of the posterior wall of the hypopharynx extending upwards into the left lateral wall of the pharynx, almost to the region of the base of the tonsil. The left side of the larynx was swollen and the vocal cord was immobile.

Barium swallow showed a lesion extending upwards to the 3rd cervical vertebra and downwards to the region of the 7th cervical vertebra (see

Fig. II). Biopsy showed grade III squamous carcinome and there were glands in the right side of the neck.

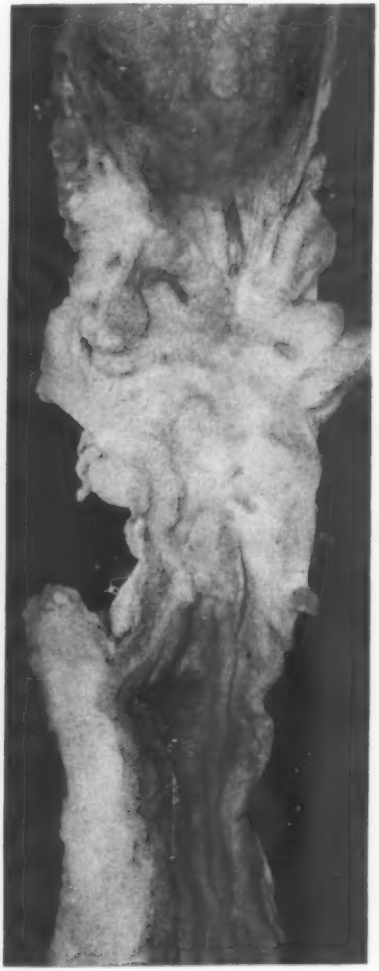

FIG. X. Case 8: Post-moterm specimen showing tube joined above to base of tongue and below to oesophageal mucosa. The lower end was extremely narrow, being the diameter of a lead pencil.

This patient was considered unsuitable for any surgical attempt and was treated with Cobalt therapy. He had some temporary relief following this and was able to swallow thick soups, toast and eggs. This improvement, however, did not last long, and he soon developed further dysphagia and gross dyspnoea which eventually required tracheotomy. He died five months after diagnosis.

Case 8

Female, aged 67 years, first seen July, 1957, complaining of dysphagia for many years increasing markedly over the previous twelve months and hoarseness for one month. She had had anaemia for many years. Examination revealed a post-cricoid lesion extending up into the hypopharynx; the larynx and trachea were normal. Biopsy showed grade II squamous carcinoma and the cervical nodes were clinically free.

Soft-tissue X-ray showed clearly the extent of the lesion (Fig. V) and barium swallow similarly outlined the lesion well (Fig. VI).

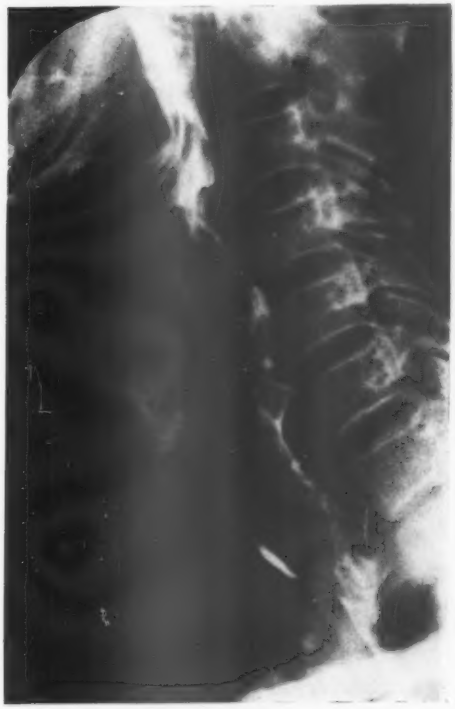

FIG. XI. Case 9: Barium swallow, lateral view, showing extent of the lesion in the post-cricoid region and showing also barium entering the trachea and outlining the tumour extension within the larynx. (Compare with Fig. XII.)

On the 13th August, 1957, a one-stage laryngopharyngectomy with primary sleeve-graft reconstruction was performed (Fig. VII).

The mould was removed after two weeks and the patient was able to swallow normally. Barium swallow at this time showed adequate sized lumen of the new pharynx.

Within six weeks she developed stenosis at the lower end of the graft and needed frequent dilatations for the rest of her life.

In June, 1958, she developed an enlarged gland in the right side of her neck and a block dissection of the right neck was performed. She remained apparently well and free of disease until about January, 1959, when she became depressed and suicidal. She was admitted to a psychiatric institution where she had some shock therapy. Whilst there, she developed bleeding from the mouth and nose, which proved to be due to lacerations in the back of the pharynx, produced, I feel, in her attempts to dilate her stricture. She did not improve mentally and died in July, 1959.

Post-mortem revealed evidence of malnutrition, but no evidence of any residual disease. The post-mortem specimen of the skin tube is seen in Fig. X.

FIG. XII. Case 9: Photograph of specimen, showing exent of disease in pharynx and cervical oesophagus and extension into trachea, where fistula was found.

Case 9

Female, aged 74 years, first seen January, 1959, complaining of dysphagia for many years, becoming worse over the previous three months. At the time of her admission to hospital, she could swallow only a small amount of fluid, and each attempt at swallowing induced coughing. She had lost 3 stone in weight.

X-ray by barium swallow showed a post-cricoid lesion extending down the cervical oesophagus into the thoracic inlet, and suggested a fistula into the trachea below the larynx (Fig. X).

Laryngoscopy and bronchoscopy confirmed this. Biopsy of the lesion and of a mass in the posterior wall of the trachea, showed grade II squamous carcinoma, the cervical glands were not clinically involved.

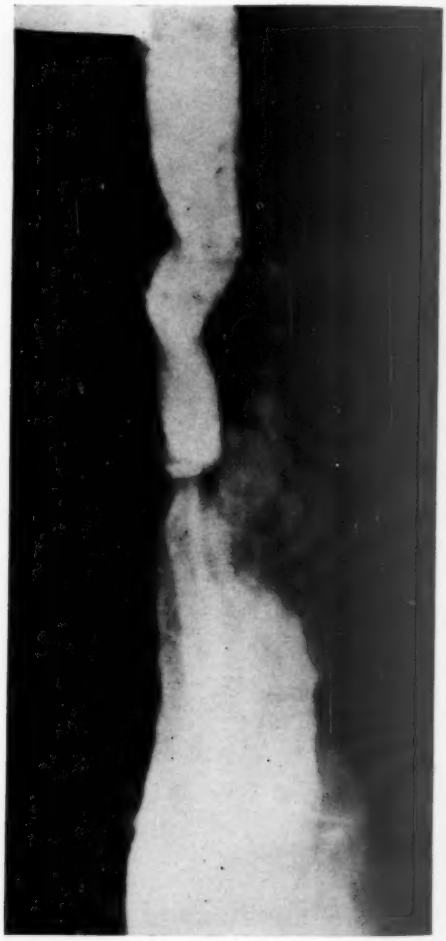

FIG. XIII. Case 9: Barium swallow showing wide passage formed by stomach joined to tongue and pharynx and outlining thoracic position of the remainder of the stomach.

On the 27th January, 1959, operation was performed including laparotomy and mobilization of the stomach leaving its blood supply coming from the right gastric and right gastro-epiploic arteries only; right posterolateral thoracotomy and mobilization of the oesophagus including the lower end of the growth, and delivery of the stomach into the thorax; laryngo-pharyngectomy and anastomosis of the fundus of the stomach to the base of the tongue and pharynx (Fig. XII).

She made an excellent recovery, being able to swallow fluids in forty-eight hours, and solids by the end of the week (Fig. XIII).

In view of the extent of the lesion, the whole of the thyroid and parathyroids were removed with the laryngo-pharyngectomy. Post-operative hypoparathyroidism was initially difficult to control, but with oral Calcium Gluconate and Vitamin D, she has maintained herself satisfactorily.

In June, 1959, the patient presented with a mass in the right side of the neck and a right neck dissection was performed. She has recovered well from this and is at present showing no signs of any further disease.

SUMMARY

An experience with cases of carcinoma of the pyriform fossa and hypopharynx is reviewed. The need for awareness of early symptoms and thorough examination of patients with such suggestive symptoms is stressed.

The uniformly bad results of carcinoma of the pyriform fossa are noted and suggestion for the consideration of radical surgery in some of these cases is made. The problems associated with the management of carcinoma of the hypopharynx are discussed and the results of treatment of 9 cases are reviewed.

Case histories of these 9 cases are given in some detail.

ACKNOWLEDGEMENTS

I am indebted to Rev. Sister M. Regis of the Department of Medical Illustration, St. Vincent's Hospital, for the photographs and illustrations in this article.

I express my thanks to Dr. L. Atkinson for his helpful co-operation in the management of these cases and to Mr. Edward G. MacMahon for permission to include Case 3 in this review.

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CARDIAC OUTPUT UNDER ANAESTHESIA*

By B. Dwyer and E. George

St. Vincent's Hospital, Sydney

IT is over three hundred years since Harvey delivered his classical treatise on the circulation in man. When he described the output of the heart he stated:

"I know and state to all that the blood is transmitted sometimes in larger amounts, other times in a smaller, and that the blood circulates sometimes rapidly, sometimes slowly according to temperament, age, external or internal causes".

Traditionally, the information available to anaesthetists as to the circulatory state of their unconscious patients is of the same order of accuracy, as they rely, simply, on a record of the arterial blood pressure and pulse rate. The numerous variations encountered are a constant source of concern and confusion. Quantitative evidence of the degree and direction of changes in cardiac output is required particularly in the face of increasing surgical demands and complex anaesthetic techniques.

Accordingly, it is proposed to review briefly the basic physiological facts relating to the cardiac output, the methods available for its estimation and to describe the method employed at St. Vincent's Hospital.

Physiology

The output of the heart depends on the venous return, the force and frequency of the beat and, together with the peripheral resistance, is intimately related to the blood pressure.

Grollman measured the minute volume under basal conditions and found that it varied in different individuals from 3 to 4.6 litres. Later Cournand, using the direct Fick method of estimation, obtained the higher figures of 5.5 litres in adults.

Grollman showed that the basal cardiac output was a function of the surface area of the body with an average of 2.2 litres per square metre. This is termed the cardiac index. With his method Cournand obtained the higher figure of 3.12 litres per square metre in adults, with still higher figures in children. When related to body weight the cardiac output was 62 ccs. per kilogram. The average stroke volume is from 60-70 ccs.

The peripheral resistance depends on the calibre of the small vessels (arterioles mainly) and the viscosity of the blood. It is calculated from the mean arterial pressure (diastolic pressure + 1/3 pulse pressure) and the cardiac output. For convenience it is expressed in absolute units of force ($\frac{\text{dyne secs}}{\text{cms}^5}$) and the average normal is from 600 to 2,000 units although it may be as high as 5,000 units in arterial hypertension.

Numerous physiological and pathological states influence the cardiac output. Muscular exercise, pregnancy, rise in temperature, digestion, emotion, carbon dioxide retention, anaemia, hyperthyroidism, arterio-venous fistulae, Paget's disease and beriberi all raise the cardiac output.

Anoxia, the erect posture, cardiac irregularities, valvular disease, myxoedema, pericarditis, pneumothorax and intermittent positive pressure respiration, shock and surgery will reduce the cardiac output.

Methods of Estimating Cardiac Output

The Fick principle

In 1870 Fick proposed that the blood flow through an organ could be measured by estimating the arterio-venous difference of a metabolite and the amount of metabolite consumed in a given time.

To obtain true samples of mixed venous blood cardiac catheterization is necessary. Thus this principle could not be applied in man until Forsmann in 1929 performed his classical self-catherization experiments which were further elaborated in 1941 by Cournand. This method has since been considered the most accurate available and the standard by which all others are judged.

*Received for publication 15th October, 1959.

By the direct Fick method the cardiac output is obtained from the following formula:

$$\text{Cardiac output per minute} = \frac{\text{total } O_2 \text{ consumption per minute}}{\text{arterio-venous } O_2 \text{ difference}} \times 100$$

The indirect Fick method of Douglas and Haldane is based on the CO_2 arterio-venous difference; the cardiac output is then obtained from the following formula:—

$$\text{Cardiac output} = \frac{\text{total } CO_2 \text{ elimination}}{\text{arterio-venous } CO_2 \text{ difference}} \times 100$$

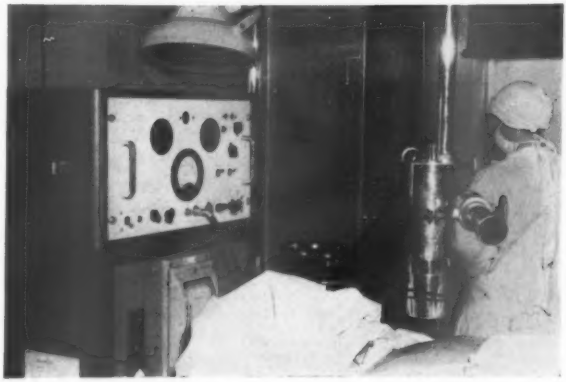

FIG. I. Showing the general arrangement of the equipment in use in an operating theatre for the assessment of cardiac output during a left ventricular puncture. The vertical collimated scintillation counter is seen over the chest and is connected to scaler and ratemeter placed behind the patient's head.

Use of foreign gases

The subject breathes an inert foreign gas (i.e. one which dissolves in plasma but does not combine with any of the constituents of the blood). The amount of the gas absorbed in a given time is measured and when its coefficient of solubility is known, the amount of blood passing through the lungs in that time can be calculated. Grollman used acetylene for this purpose.

Physical methods

A. Ballistocardiographic method

First described in 1905 by Yandell Henderson, this method invokes the basic principle that "to every action there is an equal and opposite reaction". The cardiac output is calculated from the record made by the recoil of the body caused by movements of the heart and the impact of blood during systole. In 1939 Starr related the magnitude of the impulses to the stroke volume. Results of this method proved impossible to interpret in any but a normal subject. Its value is limited.

B. Pulse pressure method

This method follows the principle that the stroke volume can be calculated, if the following data are known:

1. The volume of the arterial vessels at the end of diastole,
2. The outflow from the arterial system during the cardiac cycle, and
3. The distensibility of the arterial walls.

According to Starr these facts can be obtained from a simple record of the systolic and diastolic blood pressure. He uses the following formula:

Stroke volume = 100 + 0.5 pulse pressure — 0.6 diastolic pressure — 0.6 age (years). Cardiac output = stroke volume × heart rate.

This formula is empirical and devised from series of published reports of the cardiac output (determined by the Fick method) when the blood pressure was also mentioned. He claims the results to be within 10 per cent. of those obtained by the acetylene method.

Greene considers that the pulse pressure formulae are ideal for investigations of problems involving acute fluctuations in the blood pressure and they give useful information as to the direction and general magnitude of

changes in the cardiac output. Practically speaking, if the results are reasonably accurate, this method is of great value to the clinical anaesthetist, as no complicated equipment is required and the results are available instantaneously.

Dilution method

Stewart in 1897 postulated that the arterial dilution curve of a substance injected into a peripheral vein could be used to determine the cardiac output. Kinsman (1929) and Hamilton (1948) used the blue dye, T1824, as the marker substance and Nylin in 1945 first employed a radio-active isotope. Arterial puncture was necessary to obtain serial samples in which the concentration of the marker substance was estimated. In 1954 Veall reported successful measurements of cardiac output with radio-isotopes using an external scintillation counter situated over the great vessels of the chest. Seldon *et alii* (1958) found this method to be as accurate as the Fick method and it has since been used in some 130 estimations at St. Vincent's Hospital.

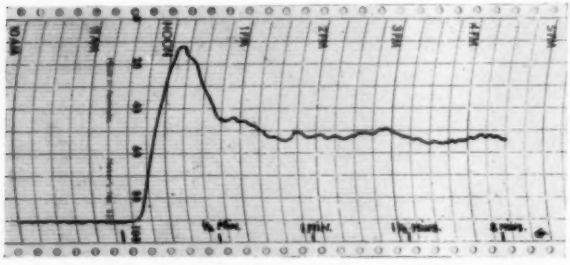

FIG. II. A typical tracing of an isotopic dilution curve recorded by the equipment shown in Fig. I. The time scale is indicated on the bottom line. At zero time the injection was made, each vertical line is an interval of six seconds. From this curve it may be seen that the appearance time is 6 seconds and that the time to reach the maximum of the curve is 18 seconds. Recirculation commences after 33 seconds and the remainder of the curve has to be obtained by calculation as shown in Fig. III.

Radiographic method

The stroke volume is calculated, in this method, from the area of the heart shadows in instantaneous skiagrams taken in cardiac systole and diastole.

RESULTS

The cardiac output and total peripheral resistance has been estimated in 20 anaesthetized patients with the radio-isotope dilution method described by Seldon, Hickie and George (1958).

The patient is given one gramme of potassium iodide daily, one day before and for three days after the test to minimize radio-iodine uptake by the thyroid gland.

With the patient supine a collimated scintillation counter is placed over the second left intercostal space close to the sternal border and one inch or so from the skin (Fig. I.). The position of the counter relative to the patient must not be altered until the end of the procedure. The counter is connected to a ratemeter which is graphed on a strip chart recorder.

Twenty-five microcuries of radio-active iodinated human serum albumin (RIHSA) is diluted to one ml. with isotonic saline and injected rapidly into a suitable large vein in the arm.

This bolus passes quickly through the heart and the resulting wave of radio-activity flowing through the great vessels is shown on the chart. A typical result is shown in Fig. II. After ten minutes when the isotope is thoroughly mixed with the total circulating blood volume, 10 mls. of blood is collected in an oxalated tube and its radio-activity is compared with an aliquot of the injected material. The patient's blood volume is determined by simple proportion.

The cardiac output is obtained from the formula:

$$\text{Cardiac output} = \frac{\text{Blood volume} \times \text{final concentration of isotope in the blood.}}{\text{Area under the curve.}}$$

The area under the curve is obtained by completing the descending limb (by semi-logarithmic extrapolation) which is interrupted by the return of RIHSA which has completed one circulation. This depends on the fact that the marker concentration decreases in an exponential fashion if recirculation does not occur (Kinsman, 1929). This extrapolation is shown by the cross-hatched area in Fig. III.

From this method the total peripheral resistance, circulating blood volume and mean circulation time could also be adduced.

This method was chosen firstly because a physicist (Dr. E. George) and the necessary apparatus, were available in the hospital. In addition, however, the method has several practical advantages.

1. It is simpler and safer than the Fick method and as accurate. The irradiation to which the patient is exposed is less than that encountered in cardiac catherization.

2. As the number of veins available is limited, the Fick method cannot be repeated often, yet the isotope method may be used 2 to 3 times per week in an adult.

3. The equipment required is reliable, available, portable and easily maintained.

4. It can be performed in any location.

5. It causes no physiological or psychological disturbance to the patient even if he is seriously ill.

6. The output is measured almost instantaneously — over a period of 20 seconds, so there is no time for any variation in the patient's condition or depth of narcosis. The Fick method, on the other hand, is performed over a 4-minute period.

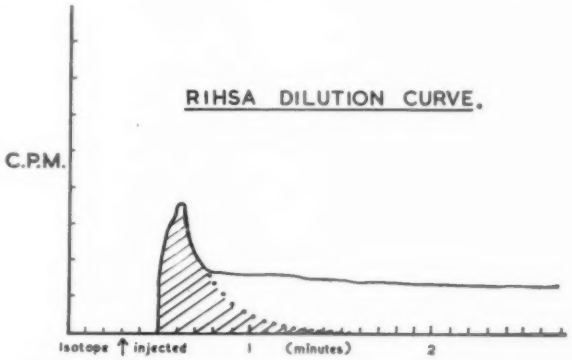

FIG. III. A tracing of a dilution curve in which the down-sweep of the curve after the maximum has been extrapolated by calculation. The curve so extrapolated is shown cross-hatched. It is the cross-hatched area that is used in the assessment of cardiac output.

The effects of three drugs, thiopentone, "Presuren", and halothane, on the cardiac output were studied in patients about to have routine surgical procedures. The entire estimation, including induction of anaesthesia, took about 30 minutes. Premedication was with atropine 0.6 mgm. and pethidine 50 mgm. in most cases, in order to exclude the possible effects of large doses of depressant drugs. If a patient appeared nervous or excited on arrival at the anaesthetic room, the procedure was not carried out. Only the drug under study was used to provide anaesthesia. The pulse rate and blood pressure were recorded every 2 to 3 minutes by the usual clinical methods. As only two additional venepunctures are necessary with this method, no patient suffered any physical or psychic trauma. Estimations of cardiac output were done before and after anaesthesia and the peripheral resistance, blood volume and mean circulation time were measured simultaneously. No alteration of the blood volume was seen with any drug.

Thiopentone

To establish the technique, the effects of a single dose of thiopentone were first investigated. Later, in healthy young subjects, the dose of thiopentone was increased until a definite fall in blood pressure occurred.

In 5 patients there was no significant change in blood pressure after a single injection of 500 mgm. of thiopentone. Two of these patients showed no alteration in output or peripheral resistance and in the remaining 3 the cardiac output rose while the peripheral resistance fell.

The blood pressure fell definitely in 3 patients. In 2 the cardiac output actually rose but there was marked depression of peripheral resistance. In the remaining case the reverse occurred.

In general these findings agree with Greisheimer *et alii* (1955) but are at variance with Elder *et alii* (1955) and Fieldman *et alii* (1955) who found a consistent fall in cardiac output under thiopentone anaesthesia.

"Presuren"

Hypotension has been reported after induction of anaesthesia with "Presuren". This was observed in 2 of the 3 patients studied and in each there was a definite fall in cardiac output and a slight rise in peripheral resistance.

It appears as though this drug in larger dose causes direct myocardial depression. This study was not continued because 2 patients experienced severe thrombophlebitis after "Presuren" as did others who were given the drug in a clinical trial.

Halothane

Early reports of severe hypotension under halothane appeared with confusing explanations as to its real cause. In this series 7 patients have been studied. They were induced with halothane alone using a "Fluotec" vaporiser and a flow of 4 litres of gaseous vehicle. This was led into a closed circuit (Boyle Moder H circle absorber unit) from which there was constant spill. Anaesthesia was maintained for 15-30 minutes with 3 per cent. halothane until a stable level was produced and/or hypotension occurred. Blood concentrations of halothane were not done as the prime object was to produce a degree of hypotension and then determine whether this was due to a fall in cardiac output or lowered peripheral resistance.

In 6 patients the cardiac output fell significantly while in the remaining one there was a small rise. The peripheral resistance was increased slightly when hypotension was not marked but fell when the drop in blood pressure was severe or when the cardiac output rose. The impression was that halothane produced direct myocardial depression from the outset and severe hypotension was prevented by a rise in peripheral resistance due to sympathetic activity. As anaesthesia progressed this compensatory mechanism began to fail, depression of the myocardium was more severe and the blood pressure fell. These effects were greatly increased by any fall in blood volume due to haemorrhage. These findings agree with those of Severinghaus and Cullen (1958) and Burn *et alii* (1957), but are at variance with the rise in cardiac output under halothane reported by Payne *et alii* (1959).

SUMMARY

The basic physiology of the output of the heart and the total body peripheral resistance and their relation to the blood pressure are reviewed together with their methods of estimation.

The radio-isotope dilution method of cardiac output determination is described in detail and the effects of thiopentone, "Presuren" and halothane on cardiac output and peripheral resistance were studied in a few cases.

The application of this method to the investigation of new anaesthetic agents, the causes of hypotension under anaesthesia and the management of hypotensive states appears to be most useful. It has definite advantages over the other techniques available.

In clinical practice, anaesthetists may use Starr's pulse-pressure formulas to obtain a better indication of the direction and magnitude of the changes in the cardiac output under anaesthesia.

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COLECTOMY AND ILEORECTAL ANASTOMOSIS IN THE SURGICAL TREATMENT OF ULCERATIVE COLITIS*

By A. F. G. ANDERSON†

Research Department, St. Mark's Hospital, London

SINCE ulcerative colitis was first described as an entity in 1875 by Willis and Moxan, methods of treatment have been many and varied. Initially, the therapeutic mainstay was irrigation of the colon and rectum, and in 1893 to facilitate this, Mayo Robson (1893) advocated establishing an iliac colostomy. Later caecostomy, appendicostomy and loop ileostomy had their champions. Brown (1913) stressed that the main value of an ileostomy was to defunction the bowel rather than to facilitate irrigation, and that a terminal ileostomy was more efficient and more easily managed than a tangential one. An increasing proportion of cases were submitted to ileostomy and, such people as Lahey and Rankin, advised earlier recourse to surgery. The aim was to restore continuity when the colon had recovered but, in fact, few were found suitable and many of these recurred after closure of the ileostomy.

It was then seen that ileostomy alone was not enough and that colectomy was necessary. Miller (1949) advocated combining ileostomy and colectomy in one stage, followed by excision of the rectum if this appeared necessary. He reported 24 cases with no operative mortality, but in 2 cases, in whom the rectum was not excised, a severe exacerbation of disease in this segment led to death from haemorrhage and infection in one, and perforation and peritonitis in the other.

It was then recognized that in the severe and fulminating cases colectomy was essential at the first operation. Many had stated that these gravely ill patients were not fit for such major surgery, but, as Ferguson (1948) stated, "These patients are too sick not to be operated upon".

Devine and Devine (1948) published a report on a staged operation they devised with ileoproctostomy as the first stage and ultimately colectomy, thus preserving rectal function. There were 7 cases in their series, and, after the first stage, there was one operative death, and one late death, from obstruction. The 5 remaining cases had all the stages completed and 4 of these had good functional results. The fifth case was well, and sigmoidoscopically had a normal rectum, but had 8 to 10 bowel motions in twenty-four hours — several of these being at night.

Gabriel (1952, 1953) has treated 6 cases after this method—3 of these had a severe "flare up" of proctitis, and 2 developed severe perirectal suppuration leading in all to excision of the rectum; the sixth case died of intestinal obstruction.

However, Corbett (1952, 1953), using a modification of Devine's procedure in 12 cases, had good initial results in all, although, in 2, symptoms recurred several years later.

Aylett (1952, 1953, 1955, 1957, 1959) advocates colectomy and ileorectal anastomosis as the primary method of choice in all cases of diffuse ulcerative colitis requiring surgery. Aylett (1959) recently reviewed 100 consecutive, surgically treated, cases of ulcerative colitis, all by colectomy and ileorectal anastomosis. This operation had been done in stages with temporary decompression of the anastomosis by a proximal tangential ileostomy. There was an operative mortality of 3 per cent.; 5 had not completed their surgical treatment at the time of review; 1 had since had an ileostomy established elsewhere. He claims that the remaining 91 patients had good functional results with 77 having 6 or less bowel motions in twenty-four hours. There has been no case in his series of late recurrence of the disease.

Best (1952) reviewed 12 cases in whom an ileoanal anastomosis had been performed for a variety of lesions, including ulcerative colitis. Only 6 achieved a satisfactory result and this after frequent and severe post-operative complications.

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†Present address: Wellington Hospital, Wellington. New Zealand.

Cattell (1953) stated, from his experience, that attempts at ileorectal anastomosis were doomed to failure and that at the Lahey Clinic this procedure was not now considered.

Brooke (1956) pointed out that severe complications of the disease may arise for the first time when the rectum alone remains, as after colectomy and ileorectal anastomosis, and quoted such a case with severe arthritis commencing in these circumstances.

Hughes (1958, 1959) stated that, of 5 patients on whom he performed colectomy and ileorectal anastomosis, 2 had satisfactory results. A further 5 cases done elsewhere were referred to him. In 4 of these there was severe diarrhoea (20-40 times daily) necessitating ileostomy and in the fifth a carcinoma had developed in the rectal stump.

Goligher (1956) gave his experience with 15 such operations. He found it necessary to excise the rectum and reconstitute an ileostomy in 4 of them.

There can be no doubt that if a good result could be confidently expected from colectomy and ileorectal anastomosis this would be preferable to a permanent ileostomy. No one can dispute the desirability of sphincteric control, no matter how well fashioned the ileostomy, how good the appliance, or how well adapted the patient.

Selection of material

A study has been made of a series of cases with ulcerative colitis who have had a colectomy and a restorative operation to preserve rectal function. Although the anastomosis is referred to as an ileorectal one, this has not been strictly interpreted, as cases have been included in which the ileum has been anastomosed to the terminal part of the sigmoid colon, just above the level of the sacral promontory. In addition, 4 cases, in whom the caecum and a little ascending colon have been preserved, have been included.

In the case records of St. Mark's Hospital there are 36 cases who have had restorative operations for ulcerative colitis and allied conditions. Those cases with associated Crohn's disease of the small bowel (6) or segmental colitis (3) have not been included. In addition, 3 further cases were excluded: one having a short segment of colitis with an associated carcinoma of colon; another having a concomitant carcinoma of bronchus to which he succumbed within several months; and the last case having multiple fibrous strictures of uncertain aetiology, but no evidence of active ulcerative colitis at the time of resection. The remaining 24 cases form the nucleus of this study. A further 10 cases, operated upon by surgeons on the staff of St. Mark's Hospital, at other hospitals, have been included, making a total of 34 cases.

This number forms a small proportion only of the total number of cases of ulcerative colitis treated surgically by this group of surgeons.

TABLE 1

RESULTS FOLLOWING COLECTOMY AND ILEORECTAL ANASTOMOSIS FOR ULCERATIVE COLITIS

Good	11	18
Satisfactory	7	
Poor	5	16
Late recurrence	6	
Immediate failure	3	
Anastomotic leaks	2	
Total	34	

In the study of the results of an operation such as this, many factors must be considered. The frequency of bowel action is not the only criterion. The ability of the patient to lead a normal life, remain in good general health and maintain weight are important. The number of bowel motions per twenty-four hours may be misleading, but there is no doubt that to have to get up at night regularly for this purpose is a definite disability. The haemoglobin level and E.S.R. are other indices of value.

The assessment of the result of a given case is not final, for at various times in its post-operative history this may change, e.g. one with a poor initial result who later improves. There is, therefore, a difference between immediate and late results.

The results at the time of this review were classified as follows:

RESULTS

1. Good result — 11 cases

Patients in this category were symptom free and in full employment. They had between 1 and 4 formed or semi-formed motions a day, without urgency, with normal control, and no motions during the night. These patients were all well pleased with their result and regarded themselves as having normal bowel function.

2. Satisfactory result — 7 cases

These patients had up to 6 motions in twenty-four hours. The motions tended to be looser than those in category 1, but in all, control was good and in none was more than one of the motions during the night. All of these patients felt well and were able to follow their full employment. None of them was at all dissatisfied.

3. Poor result — 5 cases

Here there is definite disability with more frequent bowel actions, especially at night, and poor general state of health. Two patients in this category ultimately died. Six further patients had poor results initially, but after a year or so their general health and rectal function improved to give in the end a satisfactory or good result.

4. Late recrudescence of disease — 6 cases

It has been observed, that, in some cases in one of the foregoing categories, there has been a flare up of disease of varying severity in the remaining rectal stump, with increased frequency of defaecation, tenesmus, passage of blood and pus and constitutional signs of toxaemia. Where such a recurrence has been irreversible the cases have been placed in this category. In 5 the rectum was excised and an ileostomy established. One died of perforation of the rectum and peritonitis. Two further recurrences subsided with medical treatment.

5. Immediate failure — 3 cases

This category includes those cases which had severe diarrhoea, with copius fluid loss and toxaemia, immediately following the restorative operation, to such a degree that it could not be controlled, and a terminal ileostomy had to be established and the rectum removed before the patient could recover.

6. Post-operative dehiscence of ileorectal anastomosis — 2 cases

The title of this category is self-explanatory.

CONTROL SERIES

Colectomy and ileorectal anastomosis in familial polyposis coli

The very good results achieved in cases of familial polyposis coli subjected to this type of operation have been remarkable and so these cases have been studied for comparison. Amongst the series of such cases seen and treated at St. Mark's there have been 24, uncomplicated by malignancy, who have had a colectomy and ileorectal anastomosis. It cannot be claimed that polyposis cases have absolutely normal rectums. Prior to operation, this segment of bowel is cleared of polyps by repeated fulguration, and from time to time, post-operatively, as new polyps appear, these are similarly dealt with. It is conceivable that such treatment could damage sensory nerve endings, or the musculature, causing fibrosis, but because the lesions are superficial and limited to mucosa, they can be coagulated accurately. When the area re-epithelializes, the new mucosa is supple, mobile and appears normal, and the rectum remains distensible. These 24 cases are, therefore, in the nature of a control group.

Of these 24 cases, 15 had up to 3 bowel motions a day, and 7 cases had 4 to 6 motions a day. Thus 22 had good or satisfactory results. The remaining 2 cases had more frequent bowel actions; the one, 6 to 7 motions; and the other 10 to 12 motions in twenty-four hours, with 2 to 3 of these during the night.

When the length of remaining rectum was considered, there were 15 with more than 14 cms. Of these 10 were good, and 5 satisfactory. Of the 7 cases with between 11 and 13 cms. of rectum 5 were good, and 2 satisfactory. One case with the anastomosis at 7 cms. had 6 to 7 motions a day, and another, with the anastomosis at the anorectal ring, 10 to 12, and both with urgency.

The consistency of the bowel motion was formed in 7 (in 5 of these the rectal segment was greater than 14 cms.) and soft in 16. In only one were the motions fluid and this was the case with the anastomosis at 7 cms. The patient with virtually an ileoanal anastomosis had formed motions. This demonstrates how the terminal ileum can become adapted to the function of water absorption.

The conclusion to be drawn from a consideration of this control group is that, in the absence of ulcerative colitis, a rectal stump of 10 cms. or more is adequate for near normal bowel function.

MORTALITY

In the colitis series there have been no operative deaths following ileorectal anastomosis. However, during the time of follow-up, 4 patients have died.

One of these was from carcinoma of the breast. The remaining 3 patients all had poor functional results with debilitating diarrhoea. Two of these developed intestinal obstruction and died following operation for its relief, and the third had a severe recurrence of rectal disease leading to perforation, peritonitis, and death.

MORBIDITY

Anastomotic leakage

Two cases had breakdown of the anastomotic suture line with resultant leakage and peritonitis, necessitating urgent laparotomy and establishment of an ileostomy — in the one, on the seventh, in the other, on the eleventh post-operative day. Both patients survived.

While this complication is undoubtedly a hazard of the operation, these 2 cases will not be considered in further analysis of the series because a functioning ileorectal anastomosis was not in fact established.

Stenosis of anastomosis

One case had a two-stage operation with an end to end anastomosis at 12 cms. He had severe diarrhoea after this, and the anastomosis had contracted down to a small calibre. It was dilated, under general anaesthesia, to 22 Hegar with immediate improvement, and only 3-4 motions a day. The pathology of this would appear comparable with that of the ileostomy dysfunction following ileostomy stenosis.

Intestinal obstruction

In 9 cases, approximately one quarter of the series, there were episodes of intestinal obstruction, severe enough to require hospital admission. In 3 the obstruction settled with expectant treatment. The remaining 6 patients required laparotomy for its relief. Two of these, both of whom had poor functional results, and were debilitated, died within forty-eight hours of operation.

The liability to intestinal obstruction in cases of ulcerative colitis treated by colectomy is well known, and those in whom rectal function is preserved by ileorectal anastomosis are no exception.

Secondary manifestations

Three cases developed secondary manifestations of the disease after colectomy and ileorectal anastomosis.

In one there was a stomatitis with ulceration on the tongue and alveolar-buccal sulcus. This patient was one of the two already mentioned who died after laparotomy for intestinal obstruction.

The second case developed a severe polyarthritis and vaginitis, and the third, an abacterial balanitis and anterior urethritis. In both of these the rectum was the site of severe active proctitis necessitating excision of the rectum and ileostomy. The secondary manifestations rapidly regressed in the post-operative period.

Two further cases at operation were noted as having coarsely granular shrunken livers, and in both of these the functional result has been poor.

FACTORS AFFECTING THE RESULT

In considering these factors, those cases in which the disease recurred after an interval (or in which the functional result subsequently improved) have been classified according to their result before this change took place.

1. Severity of the disease (Table 2)

In assessing this aspect, the acuteness of the illness, degree of toxaemia, weight loss, severity of symptoms, frequency of bowel actions, presence of secondary manifestations, radiographic and sigmoidoscopic appearances and general clinical picture were taken into account and the cases divided into four groups. The first group was of 9 cases and these were the least acute. In some, with long histories, the possibility of malignant change was an important factor in advising surgery. The fourth group — 7 patients — was of those with the most severe disease

necessitating emergency operation. The third contained 12 cases with acute severe disease where the indications for surgery were not so urgent, and allowed of a planned operation. In group two there were 4 cases mainly with recurrent debilitating attacks.

other than established fibrosis, are reversible and that, apart from those rare cases in which the rectum has been irretrievably damaged by fibrosis or fistula formation, all cases suitable for surgery are suitable for colectomy and ileorectal anastomosis.

TABLE 2

RESULT IN RELATION TO SEVERITY OF DISEASE

Result	*Group I*	*Group II*	*Group III*	*Group IV (Most severe)*	*TOTAL*
Poor	3	1	4	2	10
Good or satisfactory	6	3	8	5	22
					32

It can be seen from the table that the distribution of good and bad results is practically the same in each group, and it cannot be deduced from this series that the result to be expected from colectomy and ileorectal anastomosis bears a direct relationship to the clinical severity of the case.

TABLE 3

IMMEDIATE RESULT IN RELATION TO SEVERITY OF PROCTITIS. (LATE RESULTS IN BRACKETS.)

Degree of Proctitis	*Good or satisfactory*	*Poor*	*Immediate failures*
Mild (20 cases)	15 (16)	5 (4)	—
Moderate or severe (12 cases)	2 (6)	7 (3)	3 (3)

2. Degree of proctitis (Table 3)

In selecting cases for ileorectal anastomosis a major factor considered is the state of the rectum as assessed sigmoidoscopically. Corbett (1953) states that there should be no more than minimal mucosal changes and that fistulae, ischiorectal abscess, stricture and severe proctitis are contra-indications to doing the operation. Aylett (1953) in the same discussion is of the opinion that rectal changes,

In this series the state of the rectum was considered important, but cases were accepted with moderate or even severe proctitis for other reasons. In 20 cases the rectum was mildly involved, the mucosa being intact, but thickened, giving a granular appearance, and rather fragile with contact bleeding. In the remaining 12 the proctitis was more severe with submucous haemorrhages, ulceration, and tags of oedematous surviving mucosa. Included in the 20 cases with minimal involvement are 10 cases who had the operation done in more than one stage. In 9 of these the rectum, before the first stage, was judged to be the site of a moderately severe proctitis, but this subsided before the rectal segment was again put in circuit.

Of these 20 cases, 15 did well initially, a further case subsequently improved, and there were no immediate failures. Of the 12 cases with marked proctitis, 3 were immediate failures, and only 2 did well initially. However, 4 cases with poor initial results gradually improved over a period, varying between one and three and one half years, to eventually warrant their inclusion with the 2 who did well from the start, and it was seen that their clinical improvement was paralleled closely by resolution of the proctitis as assessed sigmoidoscopically.

A much higher proportion of good results has been achieved in the group with a mildly affected rectal segment, and residual proctitis

bears an important relationship to the frequency and consistency of the bowel motions and the well being of the patient.

3. Degree of ileal involvement

In this series there were 8 cases which showed involvement of the terminal ileum in the ulcerative colitis process. In 7 the result was good or satisfactory, although 2 cases who also had a fairly severe proctitis took some time before this resolved. The eighth patient, who also had a severe proctitis, had a poor result, and eventually died following an operation for the relief of intestinal obstruction.

TABLE 4

RELATIONSHIP OF LENGTH OF REMAINING RECTAL SEGMENT TO RESULT

Height of anastomosis	*Number of cases*	*Number with good or satisfactory result*
0 - 4 cm	—	—
5 - 9 cm	3	Nil
10 - 14 cm	13	6
15 - 19 cm	8	8
20 - 24 cm	4	4
Ascending colo-rectal anastomosis	4	4

There was one late recurrence in this group and it is of interest to note that, when the excised rectum and adjacent ileum were examined, the rectum, especially in its lower third, was severely involved, whereas the segment of ileum showed only slight mucosal changes.

These results would confirm the concept that ileitis associated with ulcerative colitis is a secondary phenomenon dependent on the presence of disease in the caecum and ascending colon (Counsell, 1956) and, it would appear, that its presence or absence has no direct bearing on the result following ileo-rectal anastomosis.

4. Size of remaining large bowel segment (Table 4)

Accurate measurement with a sigmoidoscope of the distance from anal verge to anastomotic line is theoretically difficult, and could be influenced by various factors such as the degree of distension of the rectum and the tone of longitudinal muscle fibres. In fact, measurements on the same patient on different occasions were surprisingly constant and did not vary by more than 1 cm.

In 16 cases the size of the remaining large bowel segment was 15 cms or more and, in the other 16, measured 13 cms or less. The result was good or satisfactory in all of the first group, whereas the 7 poor results and the 3 immediate failures occurred in the group with the smaller remaining "rectum".

The 6 patients previously referred to, with moderately severe or severe proctitis who did well eventually, all had more than 15 cms of large gut remaining, whereas the 4 poor results, amongst the group with only mild proctitis, had rectal stumps measuring 12 cms or less.

The size of the remaining rectal segment is therefore important, and a stump of at least 15 cms of rectum is desirable. In the control group, as mentioned earlier, a stump of 10 cms was adequate.

5. Age of patient.

There were 12 cases in whom the disease commenced below the age of twenty-five, and all but one of them had a good or satisfactory immediate result. The 7 cases, whose age at operation was 25 years or less, all did well. The poor results, including the immediate failures, were much commoner in the older age groups.

6. Length of history

When the cases are divided up into groups according to the length of the history — up to two years, three to nine years, ten years and over — there is no significant difference in the immediate result from one group to another.

However, in the late results (i.e. including the late recurrences) of the group of 11 cases with ten or more years' history prior to operation, but excluding 2 recent cases with less than one year's follow-up, only one has maintained a satisfactory result, 4 have had the rectum excised, 2 had poor functional results (one ultimately dying), and in the remaining 2 cases, a severe flare of the disease in the rectal stump occurred, but fortunately subsided.

Apparently, those cases with long histories are less likely to attain or maintain a good or satisfactory result.

7. Amount of ileum excised

In the majority of cases a record was made of the length of ileum excised, although no attempt was made to estimate the proportion of the small intestine which this length represented.

Information was available in 24 patients in addition to the 4 ascending colorectal anastomses. The excised ileum varied in length from 1-37 cms. The poor results, including the immediate failures and late recurrences, are distributed evenly among them, and it could not be deduced that this factor had any bearing on the result of this operation.

8. Sex

There was a preponderance of females to males in this series in approximately the ratio of 2 : 1. In studies of series of cases of ulcerative colitis, e.g. Rice-Oxley and Truelove (1950) a similar female preponderance has been noted.

The relative proportions in the series of those who did well and those who did not is the same.

9. The type of operation (Table 5)

There were 6 different types of operative procedure used in these cases. It is not possible to assess the value of 3 of these because the number of cases is so small. Thus there was only one Devine operation, and one caecostomy followed by colectomy and ileorectal anastomosis.

Similarly, there is a very small group of 3 cases with an ileostomy alone as a first stage, and one of these was a technical failure at the second stage. There remains for consideration two main types of operation and a small group of a third.

TABLE 5

RESULTS FOLLOWING DIFFERENT TYPES OF OPERATIVE PROCEDURE

		Good	*Satisfactory*	*Poor*	*Late recurrence*	*Immediate failure*	*Anastomotic leak*
1 Stage	Colectomy and I.R.A.	4	4	3	2	2	1
	Colectomy and Ascending colorectal Anastomosis	2	1	0	1	0	0
Staged	Colectomy and Ileostomy I.R.A.	5	2	0	1	1	0
	Ileostomy Colectomy and I.R.A.	0	0	2	0	0	1
	Caecostomy Colectomy and I.R.A.	0	0	0	1	0	0
	Devine	0	0	0	1	0	0
	Totals	11	7	5	6	3	2 34

One stage colectomy and ileorectal anastomosis

There were 16 cases treated by this method. In 9 the immediate result was classed as good or satisfactory, 4 had poor results (and 3 of these died eventually from complications of the disease), 2 were immediate failures necessitating excision of the rectum, and the remaining case was a failure due to dehiscence of the anastomotic suture line. Of the 7 failures, 4, including the 2 immediate failures, had quite severe proctitis at the time of operation.

Two stage operation

Subtotal colectomy and ileostomy as first stage

Nine cases were thus managed. Eight cases had good or satisfactory immediate results and the one remaining case was an immediate failure. While in all of these the rectum prior to the first stage was quite badly involved, in all but one this had resolved before the second stage was carried out. This one case, with fairly severe proctitis in the

defunctioned rectal stump, was the one which had such a poor immediate result that the rectum had to be excised.

Colectomy and ascending colorectal anastomosis

There were only 4 of these, and in all of them the immediate functional result was good or satisfactory.

The group in this series which has given the best results is of those who have had a staged procedure with a subtotal colectomy and ileostomy as the first stage. It would seem that those cases in whom the proctitis in their defunctioned rectal stump has resolved are the most suitable to be considered for this procedure.

TABLE 6

LATE RECURRENCES OF PROCTITIS

Case	*Length of history (Yrs)*	*Initial result*	*Interval between operation and recurrence*	*Final result*
1	20	Satisfactory	4½ years	Resolved—satisfactory
2	17	Good	9/12 year	Resolved—good
3	13	Good	3½ years	Excision and ileostomy
4	18	Good	3 years	"
5	1 9/12	Good	2½ years	"
6	5/12	Good	2 years	"
7	10	Poor	8 years	"
8	5	Poor	1 9/12 years	Perforation and death

Late recurrences (Table 6)

Perhaps the most interesting group is of those in whom there has been a reactivation of severe disease in the rectal stump some time after an ileorectal anastomosis. One would expect from the natural history of this disease, characterised as it is by exacerbations and remissions, that, in a retained segment of large gut, there would be the risk of a recrudescence of disease. It would be reasonable to presume that the severity and course of the exacerbations would vary. Such is the case. In some cases the recurrent proctitis was of moderate severity, but settling down with general measures, whilst in others, it was bad enough to force the surgeon to establish an ileostomy, and excise the rectum. In one the rectal wall became necrotic and perforated, leading to a fatal generalized peritonitis.

As can be seen from the accompanying table, the length of time between the ileorectal anastomosis and recurrence of disease varied from nine months to eight years, but was on an average three years. From these figures it will be seen that recurrance of proctitis is unlikely within a year of surgery. In this series there are 30 patients who have been followed up for more than a year since their operation. If one excludes 2 who failed because of leakage at the suture line, of the remaining 28, 7, or one-quarter of them, have had a recurrent severe proctitis.

In cases 1 and 2 (Table 6) the proctitis was severe enough to give rise to diarrhoea and tenesmus with blood and mucus, but it resolved with general treatment, rest, codeine, etc., including corticosteroids in one of them. In case 1, who was observed personally during this phase, the proctitis was first in evidence in the rectal mucosa adjacent to the anastomotic line and then spread distally. The ileal mucosa showed no change. This episode ran a course over some five weeks.

Cases 3, 4, 5 and 6 (Table 6) all had excellent results initially. In two of these (3 and 6) recurrence coincided with a period of marked emotional stress.

Case 5 first had two and one half years of almost normal bowel function before there was a recurrence of moderately severe proctitis. This was complicated by a pelvi-rectal fistula, making sphincteric control impossible, and the rectum was eventually excised. The specimen showed extensive ulceration, especially in the lower third of the rectum. The ileum showed slight mucosal injection only.

Case 4 had a Devine type of colectomy and ileorectal anastomosis, and here again a severe proctitis occurred after three years of good bowel function.

The remaining 2 cases were poor results from their initial operation but, superimposed on this, an acute exacerbation of the disease in the rectal stump led, in one, to the need for excision of the rectum, and, in the other, to death from perforation.

Seven of these cases had previously had chronic ulcerative colitis, and in 5 of these the history was of over ten years' duration.

Prior to operation, 6 of them had only mild proctitis, while in the other 2 it had been moderately severe.

FIG. I. Recurrence of proctitis in the rectal stump; excised specimen showing adjacent normal ileum. (Mr. Henry Thompson's case.)

It might have been anticipated that those cases with the longer segments of retained large bowel would be more likely to have recurrence of disease, but, in this group, 4 of the cases had short rectal stumps of less than 13 cms, whilst in the other 4 it was greater than 18 cms.

In all of the cases, the disease recurred in the rectal stump, while the adjacent ileum showed minimal catarrhal changes only. It is of interest to note that in one case the proctitis was severe for a year before eventually the rectum was excised, and, although ample opportunity for reflux of infected rectal contents into the ileum had occurred, and no doubt did occur, the macroscopical and histological changes in the ileum were minimal (Fig. I). Corbett (1953) has suggested that ileal disease may be responsible for recurrence of disease after ileorectal anastomosis, but this contention cannot be supported by the study of this series.

CONCLUSIONS

That there is a place for colectomy and ileorectal anastomosis in the surgery of diffuse ulcerative colitis, cannot be denied. The statement (Aylett 1957) that this procedure is the primary method of choice is not supported by the study of this series of 34 cases. Whilst it is Aylett's practice to submit all but the very rare case to this type of operation, the cases reviewed represent a group selected as being suitable for, and judged likely to respond well to, this operation, and represent a small proportion only of the total number of cases treated surgically over the past nine years.

Thus, of the 34 cases, only 18 (approximately one half of the series) have a good or satisfactory result, and of the remainder there are but 3 who still have a functional anastomosis.

There was no operative mortality. In 9 cases there were incidents of intestinal obstruction, and 2 of these cases, previous poor functional results with consequent long continued diarrhoea and debility, died within forty-eight hours of operations for its relief.

In 6 cases the result after the operation was poor, but these gradually improved, and are now classed as good or satisfactory results. In 4 of these the improvement took place as the proctitis resolved, and it is concluded that residual proctitis bears an important relationship to the frequency and consistency of the bowel actions, and the general well being of the patient. In one case, diarrhoea was associated with stenosis at the suture line, and responded dramatically to simple dilatation.

It is concluded that, in selecting cases for this type of operation, the rectum should not be more than mildly affected as judged sigmoidoscopically, but that the presence of ileal involvement is not nearly so important.

The younger patients — those less than 25 years of age at the time of operation — have been shown to have a better chance of a good result. In children, in particular, this operation should be seriously considered, as an ileostomy, for obvious reasons, is a greater burden to a child than to an adult, and even if the disease later recurs in the rectal stump, necessitating its excision, they may have gained several years of rectal function with sphincteric control. This is worth while.

Another factor considered and shown to be of some importance is the length of the history, and that group of patients who have had ulcerative colitis for more than ten years have been seen to give disappointing long-term results.

The group of patients subjected to a two stage operation with colectomy and ileostomy as the first stage, followed some two to three months later by ileorectal anastomosis, have given the best results, and the conclusion is drawn that this scheme of management is a good one. Cases with, initially, moderately severe rectal involvement can be reassessed after the first operation and, if the proctitis has subsided, leaving a rectum no more than mildly affected, an ileorectal anastomosis can be seriously considered.

The size of the rectal stump has been shown in this series to bear an important relationship to the functional result, and all those cases with a rectal stump measuring 15 cms or more from the anal verge did well initially. While it might be thought that late recurrence of disease would be more common in those with the longer rectal segments, in this series of the 8 cases which did recur, 4 were amongst those with anastomoses below 13 cms from the anal verge.

SUMMARY

A series of 34 cases of ulcerative colitis subjected to colectomy and ileorectal anastomosis has been reviewed.

A good or satisfactory result was obtained in 18. In 8 cases there was a late severe recurrence of disease in the rectal stump, following an interval (on an average three years), in which in 6 the result had been good or satisfactory. In 5 of these latter it was necessary, because of the severity of the proctitis, to excise the rectum.

It is concluded that those most likely to have the benefit of a good result following colectomy and ileorectal anastomosis are the young patients with short histories, in whom the rectum is only mildly affected, and where at least 15 cms of rectal stump is left. A very satisfactory scheme is a two stage procedure with colectomy and ileostomy as the first stage.

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RECENT TRENDS IN THE TREATMENT OF INTRA-OCULAR CANCER*

By A. Joyce

Melbourne.

RECENT literature referring to modern trends in the treatment of intra-ocular tumours has dealt mostly with the treatment of retinoblastoma and melanoma of the choroid. Some attention has been drawn to the possible management of metastic carcinoma from the hormonal aspect. This suggests at least the prospect of some further hope in the future for these conditions.

There are many types of intra-ocular tumour, some of them very rare, and some of these involve the iris and ciliary body, but my remarks on the recent advances in treatment will here be concerned with those most commonly met, namely retinoblastoma and melanoma of the choroid. Of these, retinoblastoma is that with which most success has been achieved.

Retinoblastoma

Although through the years many and varied attempts have been made to treat intra-ocular malignancy, it was not until 1929, when Foster Moore treated a retinoblastoma successfully with radon, that any plan of treatment was developed which could be said to offer much hope of cure for these tumours.

Before this time excision of the eye, usually the only remaining eye, was the usual procedure. Some ophthalmologists still maintain that this is the correct treatment because they believe that if the eye is excised the child will have a much better chance of living. If this were true it might no doubt be the best advice but unfortunately recurrence in the orbit is not infrequent even when there is no sign of growth in the optic nerve of the excised eye.

Following the success of Foster Moore, Stallard and Milner (1931), Stallard (1936) alone carried on the treatment with radon seeds, but after a time he gave them up. The seeds he used were made of glass coated platinum, they were bulky and would not fit closely on the sclera (Stallard, 1938). He then tried radium applicators but later still gave these up for the Cobalt^{60} plaques which he now uses.

In 1936 Martin and Reese (1942) treated a series of patients with retinoblastoma by X-ray which was administered by means of specially devised portals applied to the nasal and temporal sides of the orbit. The treatments were given three times a week to alternate portals for three and one-half months.

In 1953, following a report from Dr. C. Kupfer on the use of nitrogen mustard in combination with X-ray, Reese *et alii* (1957) began treating suitable cases with a reduced dose of X-ray and T.E.M. (triethylene-melamine).

These two pioneers, Stallard and Reese, have each persevered with their own methods. They have made changes and improvements in their technique with good results and they have treated far more tumours than anyone else.

In 1932 Weve treated tumours with diathermy with some success. He treated 16 patients and the tumour was destroyed in four. He was the first to attempt this kind of treatment for retinoblastoma. Later Dunphy (1957) treated several cases with diathermy and got some good results but has abandoned it. He found that the ones that were unsuccessful grew relentlessly in spite of thorough diathermy coagulation (1959). He now uses Reese's method.

Tantalum^{182} wire which has been used with success in bladder tumours has been tried by Lederman (1956) for the treatment of retinoblastoma. From 1943-1954 he reported 8 cases, 5 of which survived but no details of vision were given.

Trott and Wheatley (1956) have described details of the way in which these gamma-ray applicators are applied.

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In 1943, Kaye Scott, Anderson and Joyce (1944) began using small gold radon seeds sutured to the sclera arranged in a pattern. at the base of the tumour, calculated to distribute a homogenous dose to the tumour. The calculation of this dosage was made possible by a method developed by Oddie (1940), using the Patterson and Parker principles. Previous to this date, no attempt had been made to obtain a homogenous dose for an eye tumour. Later, Dr. Serpell took the place of Dr. Anderson in the cases we have treated.

In 1954, Zeiss developed a light coagulator after the discovery of Dr. G. Meyer Schwickereth. This has been used for treatment of detachment of the retina, and it is being suggested that it would be suitable for treating small intra-ocular tumours. As the coagulation is carried out by direct observation with the ophthalmoscope it is a very simple method to use.

This method has much the same effect as diathermy and it is open to the same objection as to whether diathermy is a wise or safe method to use in dealing with intra-ocular malignancy. Even in very small tumours it is not possible to be sure that every cell is destroyed. Also with diathermy not only the tumour cells but the whole of the tissues in the area treated are destroyed.

The linear accelerator has made a very great change in the outlook for irradiation for malignancy in general. The beam can be made very small and clear cut and as the penumbra is much less than that of 250 KV X-ray and Co^{60} it has been suggested as being suitable for the treatment of retinoblastoma. In cases where there are multiple large tumours and tumour bodies in the vitreous it might well be used in place of ordinary X-ray. It has been used in only one case of retinoblastoma in Melbourne, and although the end result is not yet known it appears to be successful so far.

This method has no advantage over radon therapeutically and in tumours which are localized radon can be applied with greater accuracy and more directly. As with X-ray there is the same difficulty with localization of the beam and positioning of the patient for each treatment with fractional doses.

Having given a brief outline of the main therapeutic measures available at present to combat intra-ocular malignancy some of the main details of each method will now be described.

Stallard's method

In a personal communication Stallard (1959) states he is now using Co^{60} applicators. These applicators have a radius of curvature of 11 mm. The Cobalt is enclosed in a cavity 0.3 mm. deep inside a platinum envelope 0.5 mm. thick. The applicators are of various shapes varying from 5 mm. to 15 mm. outside diameters, and from 1.75 to 11.5 mm. inside diameters. The dosage is planned to distribute 4,000 r. in seven days at varying distances. He uses crescentric applicators to encircle the optic nerve, where necessary, and semi-circular applicators for tumours near the limbus.

Stallard's results in the treatment of retinoblastoma have been good. During 1949-1958, he treated 59 eyes in 55 children. Of these patients there are 47 alive with useful vision. Three patients, in whom the remaining eye had been successfully treated, died from recurrence in the orbit of the excised eye one year later. Serial section of these eyes showed no evidence of any active retinoblastoma cells.

In this series there were 8 failures, 4 of these had one-half to three-quarters of the retina involved.

Stallard has also treated 45 patients with malignant melanoma of the choroid. To date his results are:—

24 successful — 18 have flat scars.
11 failures.
2 deaths.
6 uncertain.

One survived seventeen years, a bilateral malignant melanoma of choroid, aged 36, but died of carcinoma of the kidney.

Reese's method

Between 1936 and 1952, Reese and Martin treated 195 patients, and of these 24 per cent. had useful vision. Taking the last 22 cases of their series the cure rate was 50 per cent.

Their results improved as they reduced their dosage from 10,800 r. (with which they got some intractable complications) to 9,200 r. to 6,500 r. Later, following a report by

Kupfer of a retinoblastoma treated with radiation in combination with nitrogen mustard, they began to use X-ray reduced to 3,250 r. with oral triethylene melamine (T.E.M.).

In September, 1955, they discarded the oral form because vomiting and irregularity of absorption interfered with the accuracy of dosage and adopted the intramuscular injection of T.E.M. The average intramuscular dose was 7.5 to 10 mg., extended over a six to twelve-month period, compared with an average total dose of 15 mg. orally.

In 1957, Reese and his co-workers (1958) began injecting T.E.M. directly into the internal carotid artery on the side of the involved eye, giving 0.05 mg. per kilogram as an initial dose. They now estimate they get approximately a 90 per cent. cure. This method which has evolved over many years through patience, perseverance and meticulous care with technique requires a lot of time, complicated planning, exact positioning and individual attention, with precision, for each patient. Careful setting up of the patient and positioning of the portals daily is essential.

All Reese's cases have been treated at the Institute of Ophthalmology at the Presbyterian Hospital, New York. It is fitting that this should be so on account of the extreme care that is necessary in the technique and the utmost caution that is required in administering this very toxic drug. It is not a method to be undertaken lightly by isolated practitioners with limited equipment at their disposal.

The head is fixed in a device which permits no movement and the tumour dose of 3,500 r. is delivered over a three weeks period.

As T.E.M. is such a very toxic drug it has to be very carefully calculated and its effect on the patient observed. Blood counts must be watched and the white blood cell and platlet count recorded as a routine to regulate the treatment.

Reese states: "Since no therapeutic results can be expected unless hematologic depression occurs and since hematologic depression is a measure of therapeutic effect it can easily be seen how narrow is the margin during the use of T.E.M. therapy in combination with X-rays in these very young patients."

Reese has now devised a plan of treatment which, at any rate in his hands, offers a chance of recovery in those eyes which have large multiple tumours and particularly those with separate tumour bodies in the vitreous, which in the past have been regarded as hopeless. It is in this type of case also that the linear accelerator may be of use in the future.

Personal method

Where the tumours are defined and can be localized in the retina a direct attack with local treatment should be better than using chemotherapy which affects all the tissues of the body as well as the tumour cells.

The gold radon seeds used by Kaye Scott and Joyce (1958) are entirely different from those which Stallard discarded. The tumour dose is calculated by an entirely different method which Oddie (1940) discovered. The seeds are very small and fit accurately against the sclera. With them multiple distinct tumours can be treated at the one operation and the seeds are usually left as permanent implants, except when they are far forward near the cornea. They can be sutured to the sclera on any point of the globe even as far back as the optic nerve on the nasal side.

The reaction is mild and the rest of the retina is not affected. We have had no complications except in the first case we treated. In this patient, the original tumour was situated 2 mm. from the optic nerve on the nasal side. A year later a second tumour developed at 3 o'clock in the periphery. Another year later a third tumour appeared between 4 o'clock and 5 o'clock in the periphery.

The third tumour irradiation plan overlapped the previous area that had been treated. This resulted in scarring of the cornea and symblepharon and some slight opacity in the periphery of the lens. We learned from this case and we have now overcome the possibility of any such complication.

In recent peripheral tumours we have sutured plastic conformers over the seeds and then sutured the conjunctiva over the conformers. A contact lens with the centre removed has been placed over the whole area. The mucous membrane of the lids has not been affected owing to the reduction of the dosage by the extra distance.

In our last case 4 tumours each 4 mm. in diameter situated in the periphery near the ora serrata had seeds sutured at the base of each tumour in one operation, 26 seeds in all. The lids are quite clear.

To date we have treated 6 eyes with 13 tumours. The first of these patients was operated on sixteen years ago. Three tumours at twelve months intervals. He is well and was dux of his school last year. The second, a girl from Malaya, fourteen years ago, had one tumour and she is well, has 6/6 vision and there is a flat white scar where the tumour was irradiated. I saw her in Singapore in October, 1957. The third had 3 tumours treated at one operation and was left with 6/6 vision. Six years later he lost his eye in an accident chopping wood. The fourth case had a flat scar for twelve months and a quiet eye but he died from a recurrence of the growth in the orbit of the eye which had been removed before we saw him. The fifth patient had 4 tumours treated at one operation and two years later he has flat scars and the remainder of the retina is clear. The sixth patient has a flat scar over the tumour area but only eight months have elapsed.

Of these cases, 5 eyes with 12 tumours were successfully treated. The sixth case, so far, appears to be well.

The sixth case had been already irradiated in another State. There was an area of calcification below and extension of the tumour above when we saw the patient. It required complicated planning as the tumour was irregular in shape and extended from 2 o'clock to 5 o'clock in the periphery. A tongue of active tumour curved around the outer part of the calcified area.

Gibson of Brisbane and Cahill of Sydney have used radon rings with one end bent into the centre as a spoke. Gibson treated one child from 1945 to 1949 with three tumours with success although the child subsequently had a cataract removed. Cahill treated three cases, two with rings and one with 2 needles, from 1954 to 1956.

As we have only treated 6 patients we do not make any extravagant claims. We can only say that this method is simple and direct and it has been successful in these cases. The word "simple" may be misleading. It is simple in principle but the greatest possible care and patience is required in measuring the tumour and determining its exact position inside the eye. The axis of the tumour must be extremely accurately marked according to the clock face. We do this with the direct ophthalmoscope.

By means of a pointed swab stick held upright on the limbus we line up with the light beam a point on the limbus near the observer, the centre of the tumour and a point on the limbus on the tumour side. At the operation these points are marked on the limbus. It is essential to get the axis correct to measure the distance from the optic disc to the tumour edge, the diameter of the tumour and the distance from the tumour edge to the ora serrata. We find that taking the ora as being 8 mm. from the limbus is a helpful guide.

We draw a careful inside plan of the tumour and then prepare a plan of the tumour on the outside surface. The height of the tumour is measured in diopters. From this plan, a detailed dosage plan is drawn up with the centres of the seeds and their exact positions and distance from one another shown on a large scale in millimetres.

Measuring and locating the tumour is the difficult and essential part of the planning. It takes a long time, on separate occasions with the patient under a general anaesthetic and there should be at least two observers to check the measurements. The pupil must be fully dilated with atropine. As the cornea is inclined to fog easily it is better for each observer to have several quick looks than for one to spend too long at one time.

With a large clearly marked plan in the theatre the operation is not difficult if preset calipers with all the measurements are ready. The axis is sewn across the cornea and along the sclera. The centre of the tumour is marked with Indian ink.

The operation consists of measuring each point accurately and suturing each seed in its correct position.

In our case Kaye Scott does all the measuring. We mark each spot with Indian ink and put in a suture. The seed is introduced and we tie it in place.

Little overseas interest has been shown in radon seeds since Stallard discarded their use. The only resemblance between the seeds we use and those Stallard has discarded is that

they both contain radon. Our seeds are tiny and where the old seeds contained 1 or 2 millicuries, ours vary from 0.10 to 0.8 of a millicurie and the dosage is calculated by an entirely new method. As the dose of each seed is low there is no violent reaction.

Dosage

When we started in 1942 to use radon seeds for intra-ocular tumours we realised that treatment at a distance of 5mm. "h" was greater than necessary because the tumour projections of the retinoblastomas were mostly 1, 2 or 3 mm. in height. The treatment distance was therefore altered to 3 mm. "h" at which plane the dosage became homogeneous. The dosage of 6000 r. at 5 mm. "h" then became 9000 r. at 3 mm. "h".

In one case with four tumours situated near the ora the dosage was 6000 r. at 2 mm. "h" for each tumour. The dosage in the centre of the lens was 4235 r. Two years later, only a slight posterior dust-like lens opacity has been observed. The problem confronting us now is whether we can cut the dosage down further to save the lens and conjunctiva.

Diathermy

Diathermy has been advocated for the treatment of small tumours. The only advantage which diathermy offers is that it is easy to apply. Its use is attended by the danger that it not only destroys the tumour cells but all the other tissues in the area, and if all the tumour cells are not destroyed they will grow with uncontrollable vigour.

DOSAGE CHART

NUMBER OF MCS. REQUIRED TO GIVE
13,500 r. at 0.3 mm. "h" IN INFINITY TIME

Circle of Diameter of Tumour	*AREA*	*Mc. hrs. 1000 r*	*Total mcs.*	*Suggested Distribution Au. (0.3) filtered seeds*	
				Peripheral	*Centre Spot*
6 mm.	0.283 cm²	22	2.25	3 x 0.75 mc.	
7 mm.	0.385 cm²	25	2.58	3 x 0.85 mc.	
8 mm.	0.502 cm²	29	2.92	3 x 0.9 mc.	0.2 mc.
9 mm.	0.635 cm²	32	3.26	4 x 0.75 mc.	0.25 mc.
10 mm.	0.785 cm²	36	3.66	4 x 0.85 mc.	0.25 mc.
11 mm.	0.948 cm²	39	4.0	5 x 0.75 mc.	0.25 mc.
12 mm.	1.13 cm²	43	4.4	5 x 0.85 mc.	0.2 mc.
13 mm.	1.33 cm²	47	4.8	5 x 0.9 mc.	0.3 mc.

We allow 2 mm. all around for margin of error.

As practically no immediate reactionary retinal changes could be observed after this dosage it was considered safe to increase the dosage for 1 cm. diameter or less from 9000 r. to 12000 r. to 13500 r. With the increased dosage we found only mild oedema and local loss of retinal detail but no haemorrhages or sign of retinal destruction, around the tumour area.

We later became more conscious of the danger to the lens and conjunctiva so a review of dosage was undertaken to see what minimum standards might be adopted rather than the maximum dosage that might be tolerated.

For tumours raised 3 mm. we standardized on dosage of 9000 r. at 3 mm. "h", whereas with tumours raised 1-2 mm., dosage of 6000 r. at 2 mm. "h" has been used.

The light coagulator has much the same effect on tumours as diathermy and its use would be attended with similar risks. It has been used with success for angiomatosis retinae and for small vascular tumours provided that not too much is done at the one sitting. This method is not suitable for the treatment of retinoblastomata because these tumours contain very little pigment and not enough light can be absorbed to cause coagulation with certainty.

MELANOMA

If a patient has two eyes and there is a malignant melanoma in one, it is generally accepted that the affected eye should be excised, and I agree even if it should be a small tumour.

Although melanoma of the choroid is not generally regarded as being radiosensitive, the results given by Stallard are encouraging.

We have operated to apply radon seeds on 4 patients with melanoma of the choroid. The first patient had a tumour in the outer periphery of her right eye. The detachment was rounded and measured 5 disc diameters in diameter. By transillumination from the opposite side of the eye the tumour could be measured directly and its diameter was 4 mm. She had a white flat scar and her vision was 6/6 until she died six years later from heart failure.

The second patient, in 1947, had a tumour 7.5 mm., in diameter, and extending to within 3 mm. of the optic nerve. Eighteen months after treatment the centre of the tumour began to increase in size and the eye was enucleated. Sections of the tumour show that in the neighbourhood of the seeds the tumour cells were destroyed, but in the centre it was active. This patient is still alive and well.

The third patient had a large melanoma but the operation was a failure as far as sight was concerned. He still has his eye and is alive.

The fourth patient had a melanoma which measured 17 mm. in diameter by transillumination with the light behind the eye. A large detachment extended over half the retina from the tumour area. His vision was reduced to 6/36. On 5 Mar., 1955, 10 seeds were implanted on a 17 mm. circle (10 gold implants each 0.55 mc. 0.3 mm. in Pt filtration, with one centre implant 0.4 mc.) to deliver a total dose of 5.9 mc.; the dose at 3 mm. distance being 12000 r. and at 5 mm. 7640 r.

The tumour became smaller in size and less dense in appearance. The detachment was much smaller when last seen in October, 1955, and his vision was 6/60. This patient lives over 2,000 miles away in Western Australia, but he has written to say he can still see to weed his garden.

As the death-rate even when the eye is excised is high (it has been estimated at 50 per cent. within five years), I think it is worth trying to save an only eye in which there is a tumour. Radon implants would at least tend to inhibit extension of the growth.

We must realize, however, that, even if a melanoma is dealt with successfully locally, there is still the possibility of a tumour appearing somewhere else in the body although it may not be discovered for several years.

CONCLUSION

In the techniques described it is essential for the work to be carried out by a team, preferably a team which has developed their method together. Isolated attempts to try any of these methods do not offer the best chance of success. The placing of a radon seed or seeds at the base of a tumour on the sclera without an extremely carefully calculated attempt to obtain homogeneity of the dose is most likely to fail and end in the loss of the eye and perhaps the patient's life.

In Australia it might be advisable to have a team in each State to treat these tumours.

The reward of successful treatment is great and the failure to get a good result is tragic. The life and sight of the patient, usually a baby, is in the balance, and it would be best if all our knowledge and resources could be combined to ensure that the balance falls on the right side.

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BRACHIAL PLEXUS ANALGESIA*

By B. J. Pollard

Sydney

SINCE this analgesic technique was first described, it has undergone marked fluctuations in popularity, varying from extravagant acclaim as the ideal anaesthetic for arm and hand surgery, to an early and more or less complete rejection. When its use was abandoned, this was almost always because of a high incidence of technical failures and not because when it worked, it was found wanting. Unreliability was the drawback. In recent years and with certain advantages now available in the form of improved techniques and agents, brachial plexus analgesia has found its own level and takes its place with other methods in the anaesthetists' repertoire, with its own indications and unique advantages.

Historical

The method was first shown to be feasible in 1897 when Crile injected the plexus under direct vision, after surgically exposing it. The first percutaneous block was done by Kulenkampff (1911), following experiments on himself. He used the supraclavicular route and although others tried with varying success the paravertebral, infraclavicular and axillary routes, this has remained the most popular and is the only one referred to in this discussion. In due course, refinements in technique were described, principally by Patrick (1940), Macintosh and Mushin (1954), and lately by Lookman (1958), but it is noteworthy that the original technique of Kulenkampff forms the basis of most currently used methods.

Anatomical Considerations

A consideration of certain anatomical details explains why some techniques have in the past been associated with a high failure rate, while others, with only small differences, have worked well.

The plexus is blocked as it crosses the first rib and in this position, the roots of the lower four cervical and first thoracic nerves have formed themselves into three trunks, the upper, middle and lower. As these pass downwards and laterally, they lie between the scalenus medius posteriorly, and the scalenus anterior anteriorly, with the third part of the subclavian artery intervening. It is the fascial arrangements in this part which explain why, as from the beginning it has been known, if one only of these trunks is injected with an adequate volume of analgesic solution, the whole plexus can be blocked. Anatomy texts refer to this fascia but, as far as I can discover, do not describe it. Lookman provides the following description.

In the region of the posterior triangle, the plexus and the subclavian artery lie within a closed, water-tight fascial compartment, which is a paravertebral space. This space is pyramidal in shape with its apex pointing upwards towards the exit of the fourth cervical nerve and its base the upper surface of the first rib between the scalenus anterior and scalenus medius muscles. The medial border is formed by the fusion of the epineurium of all five roots of the brachial plexus with the epimysium of the scalene muscles between which they lie and by the dense connective tissue around the subclavian artery, attached to the inner border of the rib. The anterior and posterior borders are formed by the lateral borders of the scalene muscles, and the opposing surfaces of the muscles are the anterior and posterior walls. Inferolaterally, the space is in direct communication with the axillary sheath at the outer border of the first rib.

It will be readily seen that the object of any successful technique is to deposit a volume of solution within this space, adequate to bathe the plexus and even large quantities, if outside, are unlikely to be effective. For reasons to be mentioned later, single injection methods are to be preferred.

Procedure

It is true of many local analgesic methods that attention to detail can convert what could have been an unhappy experience into a satisfactory one and I am sure that this applies most decidedly to this block. The details of

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various techniques are well described by their own authors and here, I would like to discuss only those aspects which seem to me of special importance.

Firstly, the patient should be given a brief, clear explanation of what is to happen. He is told of the possibility of paraesthesiae, "like bumping your funny bone". He is warned not to move at all should they occur, but merely to say "Now". Unless this is done, he will almost certainly move suddenly, may dislodge the needle point and his confidence will be shaken if he thinks the doctor has done something he did not intend.

The aim of premedication is to produce a quiet but not sleepy patient who is receptive and co-operative without being too alert. If this result is not obtained, sedation can be supplemented intravenously, either before the block or before the operation. In any case, if lignocaine is the local analgesic used, this can be depended on to enhance sedation. Barbiturates do not prepare most patients as well as opiates and an oft-quoted basis for their use, namely antagonism to the toxic effects of over-dosage with local analgesics, has been called into question by several authors as being unfounded both clinically and pharmacologically (Sadove, 1952).

After positioning the patient with shoulder depressed and head turned to the opposite side, the side of the neck is carefully examined for the guides to the brachial plexus. Most authors recommend a given site and direction of needle entry as a rule of thumb but the brachial plexus is a subcutaneous structure and I would suggest that such an approach be reserved for the obese or thick-necked, where the landmarks are obscured. In more than half the subjects the plexus can be felt against the first rib and in more again, its position determined by gently rolling it under a finger and questioning the patient about paraesthesiae. Further guides are the subclavian artery, the scalenus anterior muscle and the external jugular vein. The scalenus anterior produces the most prominent of the vertical ridges on the side of the neck with the head in this position and it is accentuated if the chin be depressed (Murphy, 1944). The external jugular vein overlies this muscle and runs downwards parallel with it.

In the majority, after careful evaluation of the anatomical guides, the needle can be introduced in such a way that it is directly aimed at the plexus.

When this is done one of four results will be produced, and what is recommended in each case is as follows:

(1) The plexus is met and paraesthesiae occur. "Freeze" on the needle, carefully attach the syringe and inject the total dose of solution and withdraw. If the paraesthesia becomes temporarily more severe during the injection, this is certain evidence in advance that the block will be successful.

(2) The subclavian artery is entered and blood flows from the needle hub. Withdraw slightly, relocate the needle on the rib immediately posterior to the artery and inject the total dose here.

(3) The rib is encountered without (1) or (2) occurring. Here, one must decide from the direction of the needle in relation to the estimated position of the plexus, or from the intensity of transmitted pulsations from the artery whether this is the part of the rib which forms the floor of the fascial compartment. If one can be sure that it is, inject and withdraw. If not, then it is reasonable to try again in a more appropriate direction.

(4) The rib is missed and the needle goes deeper. Try again for 1, 2, or 3, and watch carefully for a pneumothorax afterwards.

The agent used is 30-40 ml. of lignocaine 1 per cent. with 1: 160,000 adrenalin. If the needle is in the fascial compartment, this will produce a satisfactory block, though in one instance where 30 ml. was used unsuccessfully, re-injection with a further 20 ml. completed the block.

Following the injection and after observing vasodilatation or heaviness of the arm, the anaesthetist may need to reassure the patient if touch, pressure of temperature perception still persist, that these will be short lived. If there is no contraindication to a general anaesthetic, it is a good idea to administer a sleep dose of thiopentone for the duration of the operation in unco-operative or uncomprehending patients.

Associated phenomena

A number of associated phenomena have been described with this procedure, but only a few will be mentioned here. The possibility

of pneumothorax is ever present and constitutes the real risk. The incidence varies inversely with the skill of the operator and it requires only one excursion of the needle past the rib for the stage to be set. In published series, it occurs with about one or two per cent. of blocks, but far more often, I suspect, in unpublished series. It usually becomes manifest within a few hours, though it may be a day or two and its severity varies through the whole range. Its importance is that it may be so severe as to require needling for relief of respiratory embarrassment and detention in hospital for observation. In a recent case, a subpleural vessel was punctured, and the patient was in hospital for his haemopneumothorax for weeks longer than he would have been for his surgical condition. This complication, however, is exceedingly rare, having only been recorded on two previous occasions.

The mode of production of a pneumothorax is not by air entering via the needle, but by a quiet escape of air from pulmonary alveoli following penetration of the visceral pleura. It is an essential part of the technique to advise all out-patients to report to the hospital in the event of subsequent chest pain or respiratory difficulty. On account of the high incidence of this complication in the hands of the enthusiastic novice, brachial block for outpatients was banned at one teaching hospital in Sydney and its use restricted to registrars and over at another. In view of these remarks, then, the single injection technique is strongly recommended and the fewer manipulations of the needle the better.

Associated phrenic nerve block, which often accompanies brachial analgesia, would need to be considered when the patient has pulmonary disease on the opposite side. When the block is to be bilateral, great care must be taken, for either bilateral phrenic block or bilateral pneumothorax could be calamitous. In these circumstances, respiratory difficulty would need urgent and efficient management. In fact, bilateral block should probably only be attempted on the fit, and even then if in doing the first side, the rib were missed, one would need to assess the position carefully before proceeding.

Although one might expect to see cases of brachial neuralgia after this block, even in large series where this has been specifically searched for afterwards, there have been very few and these transitory, lasting less than three weeks (Woolley and Vandam, 1959).

INDICATIONS

Any operation or manipulation on the upper limb can be performed under brachial plexus analgesia, with this proviso, that where an operation is to be in the shoulder region, the sensory cutaneous innervation of the inner arm and shoulder must be blocked separately. This is easily done.

It is eminently suitable for out-patient procedures of some severity, such as manipulations and reduction of fractures but it is not worth the time and effort for minor conditions, where a simpler method will suffice. Patients can be ambulatory immediately afterwards and have a period of freedom from pain.

Injuries sustained in industry, motor vehicles, etc., often occur in people who are not prepared for general anaesthesia and they can be dealt with in this way without delay. In the aged, often with associated diseases, the risk of local analgesia may be less than that of a full anaesthetic.

In the case of severe injury to the arm or hand, the progress of shock can be halted, resuscitative therapy and preparation for surgery being combined in the one procedure. Here, too, the vasodilatation produced by the block helps to distinguish, in those cases where the viability of tissue is in doubt, between reflex vascular spasm and vascular damage. In the case of reflex spasm, if promptly performed, a brachial plexus block may actually prevent further tissue loss, for example, when the main artery and the collateral circulation are both involved.

Patients generally are appreciative of a well managed block and the idea of pain relief for an operation with one injection and without loss of consciousness appeals to them. It should, however, never be used on an unwilling subject.

A tourniquet can be used if needed but this should be done with caution, as this has probably been responsible for some of the cases of brachial neuralgia. For plastic surgery of the upper limb, brachial analgesia comes nearest to filling an ideal role. In acute cases, there need be no delay in treatment, every

type of injury can be dealt with and almost no patient need be rejected on the grounds of unsuitability for the method. In major trauma, where the ultimate viability of a member may still be in doubt after adequate exploration, the surgeon may discuss the problem with the conscious patient, whose wishes may need to be considered.

In routine surgery, flap grafts to abdomen or thigh are best performed with this block plus local infiltration or spinal analgesia, thus avoiding the possibility of disruption of the wound during emergence from anaesthesia. Small grafts to finger or hand may be obtained from the same arm without further trouble.

One so-called advantage merits a comment. It has been said that it is a useful method when there is no person available skilled enough to give a general anaesthetic. My view would be that the occasional anaesthetist would do well to do what he knows, and that brachial block should only be performed by those who have learned the method under supervision. It is a luxury anaesthetic.

Kulenkampff, in 1928, after experience of 1,000 cases, made what seems to be an up-to-date and appropriate summary, namely, "The supraclavicular method of plexus block is teachable and learnable. It eliminates pain from the arm, forearm and hand and produces a motor and sensory paralysis directly proportionate to the degree of skill with which the anaesthesia has been produced".

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CAROTICO-CAVERNOUS FISTULA WITH CONTRALATERAL SIGNS*

By K. G. Jamieson, J. M. Sutherland and J. D. N. Yelland

The Brisbane Hospital and the Medical Professorial Unit, University of Queensland, Brisbane

EXOPHTHALMOS resulting from a fistulous carotid-cavernous sinus aneurysm may be unilateral or bilateral. When bilateral, exophthalmos usually develops first and is more marked degree on the ipsilateral side. In the majority of unilateral cases the signs are on the same side as the lesion.

Occasionally however, typical signs occur only on the contralateral side. Tamler (1954) collected 4 such cases from the literature and added a fifth with autopsy findings. More recently, White, Love and Goldstein (1958) described a further case and reviewed the 9 cases previously reported.

The patient reported here displayed the classical signs of a carotico-cavernous fistula on the contralateral side and external rectus paralysis on the ipsilateral side. Carotid ligation was successful in relieving the condition.

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Case Report

A.B., female, aged 74 years.

Early in December, 1958, the patient's son observed that her left eye had become unduly prominent. On 6th December she had an epileptic seizure and was admitted to a local hospital. During the following 10 days her left eye became progessively more swollen, eye movements were restricted and she was unable to elevate the left eyelid. She did not complain of pain. No history of head injury was obtained.

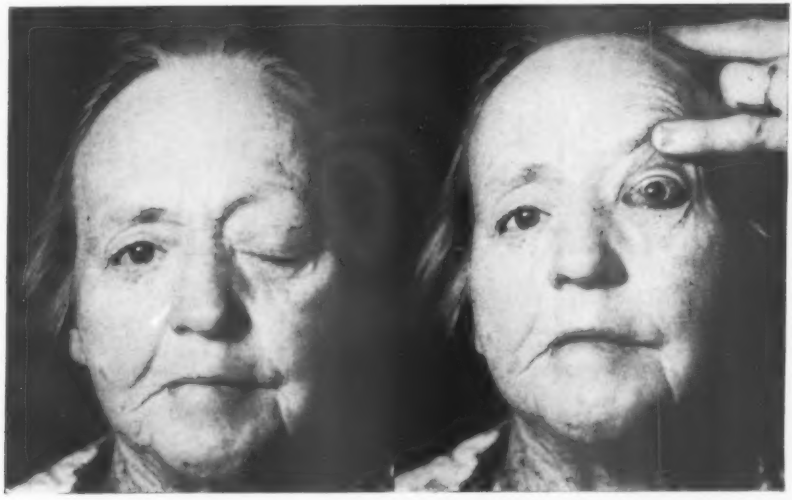


FIG. I. (a) and (b) Appearance of patient on admission to hospital.

The patient was transferred to the Brisbane Hospital on 16th December. Fig. I (a) and (b) illustrates the patient's appearance on admission. On the left side, the eyelid was ptosed and there was considerable swelling of the peri-orbital tissues. The conjunctiva was congested and oedematous and the eye itself was immobile. The left pupil was larger than the right and did not react directly or consensually to light. The fundal veins were engorged, the disc margin being, however, normal. The right eye was normal apart from paralysis of the external rectus muscle. The arteries of both optic fundi showed marked calibre variation. Intraocular tension on the right side was 20 mm. of mercury, on the left 35-40 mm. of mercury.

The proptosed left eye pulsated synchronously with the arterial pulse; there was no pulsation on the right side. A continuous cephalic bruit with marked systolic accentuation was audible, being of maximal intensity over the right eye. The bruit was diminished by digital compression of the right carotid artery; compression of the left carotid did not influence the murmur.

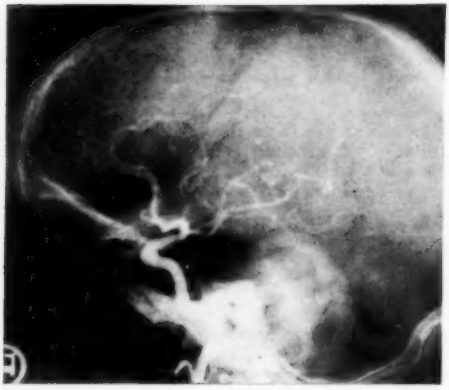


FIG. II. Left carotid angiogram.

There was evidence of generalized atherosclerosis and the blood pressure was 170/85 mm. of mercury. Otherwise clinical examination was negative. A cardiogram disclosed a partial right bundle branch block. Lumbar puncture and examination of the cerebro-spinal fluid revealed no abnormal features. The Wassermann reaction of the blood and cerebro-spinal fluid was negative.

Carotid angiography disclosed no abnormality on the left side (Fig. II). On the right side there was a typical carotid-cavernous sinus aneurysm with early filling of the cavernous sinus and rapid drainage into the jugular system (Fig. III [a] and [b]). Cross circulation tests showed filling of the left anterior and middle cerebral arteries.

Operation 1 (9th January, 1959)

Under local anaesthesia the right internal carotid artery was exposed in the neck and a Crile's clamp applied. Within five minutes of application the bruit in the head had disappeared. At the end of half an hour no untoward effects had been noted; the artery was then ligated with one strand of No. 3 Chinese twist silk.

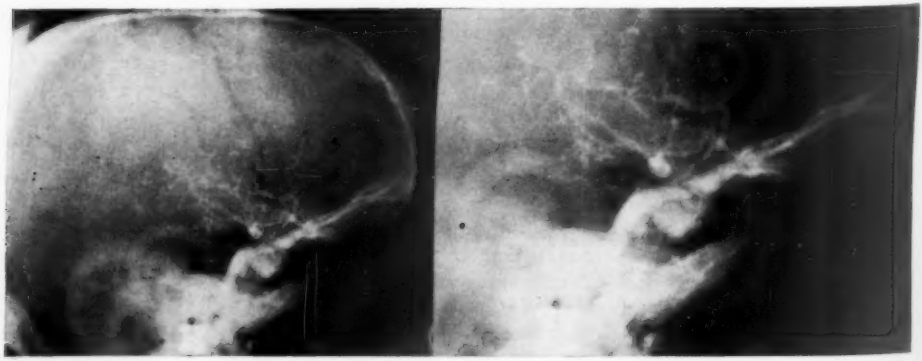
One and a half hours after ligation, left hemiplegia developed. The ligature was removed ten minutes later and recovery from the hemiplegia was almost complete eighty minutes later.

Over the next three and a half weeks the signs in the left eye became progressively worse (Fig. IV). It was decided to attempt progressive occlusion of the internal carotid artery prior to ligation. Since no special clamp was available, a clamp from a transfusion set was modified to achieve this effect (see Fig. V). This clamp was found to be similar to that subsequently described by Dimant (1959) except for the addition of an arm designed to prevent torque on the artery during its tightening, as recommended by Selverstone (1956).

Operation 2 (2nd February, 1959)

Under general anaesthesia the right internal carotid artery was again exposed and the clamp was applied. It was calculated that by tightening half a turn daily over the next week, the artery would be completely occluded at the end of this time. On the fourth day after application, the bruit disappeared. Occlusion was completed over the next three days and on 9th February the internal carotid was ligated below the clamp and the clamp was removed.

Examination one month later showed bilateral external rectus muscle paralysis and recovering left third nerve palsy. A minimal degree of left ptosis remained; the left pupil was slightly larger than the right; both pupils reacted directly and consensually to light. Vision was 6 : 24, right eye, and 6 : 36, left eye. The optic fundi were normal apart from atherosclerotic changes. No cephalic bruit was audible. Fig. VI illustrates the appearance of the eyes at this time.



(a) (b)

FIG. III. (a) Right carotid angiogram.
(b) Enlargement of area of cavernous sinus.

DISCUSSION

Drainage from the cavernous sinus is by the ophthalmic veins, the petrosal sinuses and by the intercavernous sinuses or plexus of veins. It is probable, however, that the degree of communication between the two cavernous sinuses varies from individual to individual.

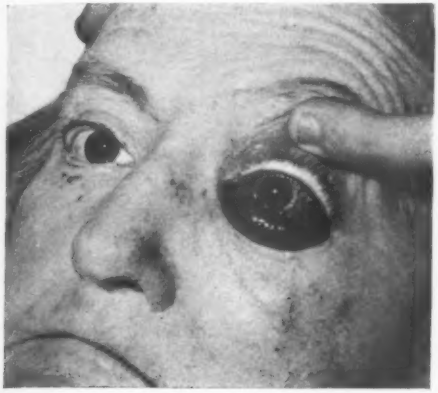


FIG. IV. Appearance of patient after first surgical procedure.

If a carotid-cavernous sinus fistula results only in unilateral exophthalmus on the side of the lesion, one might presume a poorly developed intercavernous sinus connection. On this basis, when bilateral exophthalmos results, an efficient connection exists and in cases with only contralateral exophthalmos, there must be, in addition, impaired or inadequate drainage from the ophthalmic veins on the side of the lesion.

Tamler (1954) advanced 6 possible reasons for the absence of symptoms on the ipsilateral side. One probable explanation is thrombosis of the ophthalmic veins, or an anomaly of these veins on one side whereby they do not communicate with the cavernous sinus. It is also possible that the internal carotid artery may act as a valve, permitting blood to enter the cavernous sinus, but not leave it, through the ophthalmic veins.

The importance of thrombotic episodes is suggested by the present case. For some time previous to the first operation the increase in proptosis had been slight; indeed there had been little if any change for some ten days before the operation. Subsequent to ligation of the carotid artery and later removal of the ligature, the degree of proptosis, swelling and chemosis increased markedly (compare Figs. I and IV). Meadows (1951) ascribed this occurrence to thrombosis in the cavernous sinus. In this patient it would appear that drainage from the cavernous sinus, except through intercavernous sinus conections, became critically further impaired.

FIG. V. The clamp.

Diminution of blood flow in the carotid circulation encourages clotting and spontaneous cure may occur. The patient reported by Pincus (1907) achieved this by compressing his carotid artery with a broomstick handle whilst he slept. He adopted this manoeuvre since the noise in his head tended to keep him awake, and he had observed a diminution in the intensity of the noise when the artery was compressed.

In the present patient, internal carotid compression for thirty minutes, followed by ligation, resulted in a rapidly progressive contralateral hemiplegia which commenced

one and a half hours after ligation of the artery. The ligature was removed ten minutes later and within eighty minutes the hemiplegia had almost completely recovered; the plantar response, previously extensor, became normal.

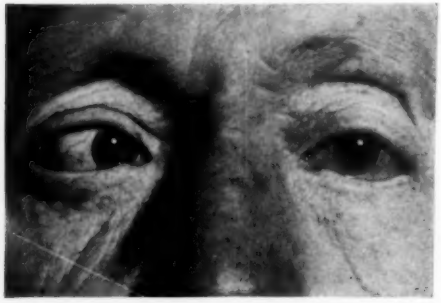


FIG. VI. Appearance of patient one month after second surgical procedure; left gaze.

It has been suggested that such sequelae of carotid ligation may be due to thrombosis. Schorstein (1940), however, reported a case of Denny Brown's who developed hemiplegia and hemi-anaesthesia forty-eight hours after ligation and at autopsy thirteen days later there was no evidence of thrombosis. Similarly, Brackett (1953) has described non-thrombotic hemiparesis occurring fifty-seven hours after ligation. It seems unlikely that arterial spasm plays a part and Symonds (1957) has convincingly explained the sequence of events in such cases.

Following internal carotid artery ligation, there is an increase of cerebrovascular resistance compensated by a rise of mean arterial blood pressure so that cerebral blood flow remains constant. If this adjustment fails there is a rise of cerebrovascular resistance and a fall of cerebral blood flow. In the ischaemic cerebral tissue carbon dioxide accumulates resulting in vasodilatation, transudation and cerebral oedema. At some stage anoxia results in loss of function and eventually infarction without thrombosis or embolism. If the ligature is removed before infarction occurs, complete recovery is possible.

From the clinical point of view, exophthalmos in cases of carotid-cavernous sinus fistulous aneurysm may not indicate the side of the lesion. The side of maximal intensity of the cranial bruit is suggestive and carotid angiography confirms the diagnosis.

SUMMARY

A case of carotid-cavernous sinus fistula with ocular symptoms on the contralateral side is reported.

Carotid ligation resulted in hemiplegia one and a half hours after ligation. This was relieved when the ligature was removed. Subsequently slow occlusion of the internal carotid by a clamp was carried out successfully.

The importance of anoxic cerebral infarction as a sequel to internal carotid occlusion is discussed.

ACKNOWLEDGEMENTS

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DESMOID TUMOUR IN FAMILIAL POLYPOSIS OF THE COLON*

REPORT OF A CASE

By E. S. R. HUGHES and J. T. HUESTON

Royal Melbourne Hospital

EARLY studies of cases of familial polyposis established two interesting features. First, the disease is transmitted as a Mendelian dominant. Secondly, without surgical intervention carcinoma develops in the colon in most sufferers (Dukes, 1958).

A third characteristic of the disease has emerged as a result of later observation. Familial polyposis is associated sometimes with an abnormal behaviour in certain other tissues. It has been known for some time that small intestinal polyposis might co-exist with bizarre skeletal and cutaneous malformations, of which the best known are melanin pigmentation of the buccal mucosa, face and other parts of the skin (Peutz, 1921; Jeghers *et alii*, 1949) and clubbing of the fingers and toes (Ravitch, 1948). Now familial polyposis of the colon has been found associated on occasions with pathologically distinct lesions.

1. Familial polyposis, osteomata and soft tissue tumours.

Gardner and his colleagues (Gardner *et alii*, 1951, 1952, 1953) published their researches into a family group of which 57 members were examined. Six individuals in the group had the triad of features, familial polyposis, osteomata of the skull bones and multiple cutaneous and subcutaneous lesions. They found most of the latter to be epidermoid cysts but they considered that fibrous and ill-defined masses of connective tissue were also present typically. Weiner and Cooper (1955) studied a family composed of four brothers and three sisters. Three of the brothers had polyposis, osteomata and multiple soft tissue tumours; the fourth brother, treated elsewhere, had osteomata and polyposis, but no soft tissue tumours; the three sisters were clear. O'Brien and Wels (1955) reported two cases in which polyposis was accompanied by osteomata and soft tissue tumours but in their cases the latter were intraperitoneal and retroperitoneal respectively. Gumpel and Carbello (1956) recorded three cases and Smith (1958) had five cases from the Mayo Clinic in which polyposis, osteomata and soft tissue tumours co-existed but most of the latter were regarded as epidermoid cysts. Lazar and Bendix (1959) published the pedigree of a family of which some members developed polyposis, osteomata and skin tumours.

2. Familial polyposis and sebaceous cysts.

Oldfield (1954) reported a family in which familial polyposis was associated with sebaceous cysts. Two brothers and one sister were involved. Their father and grandfather were known to have had sebaceous cysts but their bowel condition was never established. At least four of Smith's series from the Mayo Clinic (Smith, 1958) had the same combination. Shepherd's case had had sebaceous cysts removed some time before colectomy (Shepherd, 1958). In some cases there has been uncertainty as to whether the soft tissue swelling is a fibroma, lipoma or a sebaceous cyst.

3. Familial polyposis and intra-abdominal fibrous tissue masses.

Pugh and Nesselrod (1945) reported a patient of 38 years with polyposis who had an area, 10 x 5 cm., in the region of the splenic flexure which appeared to be composed of dense fibrous tissue. This was excised and histological examination revealed fibrous tissue.

In one of their patients with polyposis Clark and Parker (1950) noted the presence of three large retroperitoneal leiomyomas in the mesentery of the small bowel. O'Brien and Wels (1955) reported three cases with intra-abdominal fibromatous masses. In the first the mass was discovered twelve months after right hemicolectomy; it was 7 cm. in diameter and in the mesentery adjacent to the ileo-transverse colostomy. The second patient had extensive induration in the mesentery of the

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sigmoid and rectosigmoid, which biopsy showed to be fibrous and lymphoid tissue. In the third patient reported by these authors the mesentery of the terminal ileum from root to bowel wall, for a distance of 14 cm., was involved in a dense uniform mass measuring 2.5 cm. thick; histological examination showed fibrous tissue. Shepherd (1958) gave an account of a further case (referred to above) in which multiple tumours were felt in the mesentery of the upper jejunum after opening the peritoneal cavity: ". . . The jejunum was brought out and a group of discreet tumours in the mesentery was at first thought to be composed of glandular enlargements of the type found in Hodgkin's disease or in lymphosarcomatosis. These curious firm mobile tumours were confined to a triangle of mesentery. No lesion was seen in the bowel, but this was ribboned over the larger tumours and slightly obstructed. A resection of the involved part of the mesentery with adjacent bowel was feasible and was undertaken because the nature of the condition was uncertain. . . ."

Recent reports in the literature indicate that a further pathological disturbance is found in some patients with polyposis. A hard mass develops in the abdominal incision through which colectomy is performed; this has been regarded as a fibroma or as a desmoid. In the case to be reported the patient had familial polyposis, an osteoma of the left zygoma, and multiple fibrous tissue masses under the skin; a fibrous tumour developed in the abdominal wound and in the mesentery of the small bowel after surgery.

REVIEW OF LITERATURE

In 1923 Nichols reported a study of 31 cases of desmoid tumour from the Mayo Clinic. In four of these the desmoid was found in operation scars. One of these latter patients, Dr. F. S. M., aged 46 years, had undergone a right inguinal herniotomy in 1914. In 1917, examination at the Clinic revealed multiple polyposis and in February, 1919, an operation was performed through a right rectus incision. In May, 1920, the patient returned with a tumour in the upper angle of the incision. This was explored and found intimately attached to the posterior sheath of the right rectus muscle and peritoneum. Microscopic examination showed it to be a desmoid tumour. The development of the desmoid tumours in these operation scars was not considered significant.

In 1937, Miller and Sweet recorded the case history of a girl, aged 23 years, who was suffering from familial polyposis complicated by carcinoma. On the 10th July, 1930, an abdomino-perineal excision of the rectum and sigmoid colon was performed; on the 11th October, 1930, the colectomy was completed and ileostomy constructed. On the 7th February, 1931, a laparotomy for intestinal obstruction was necessary but no abnormality was found in the way of fibrous tissue. In November, 1932, a tumour the size of a small hen's egg was removed from the lower end of the left abdominal scar. It was thought to be a recurrence of the carcinoma but the pathologist reported ". . . Specimen consists of piece of tissue, 5 x 7 x 4 cm. covered on one surface by piece of skin. Skin contains linear scar 6 cm. long. On opposite side of tumour is a portion of striated muscle. On section tumour mass is rounded, apparently encapsulated and measures 3 cm. in diameter. Microscopic examination showed fibrosarcoma, desmoid type." These authors made no comment as to the association of polyposis and desmoid.

Cattell and Wiedman (1952) reported two cases of desmoid tumour in polyposis. The first patient, a female of 49 years, was found to be suffering from a carcinoma of the rectum and multiple polyposis. On the 26th April, 1941, the abdomino-perineal excision of the rectum was performed through a left paramedian incision and the colostomy was placed at the upper end of the incision. Examination on the 22nd October, 1942, showed her free from trouble but on February 3rd, 1943, a large tumour was found in the abdominal wall surrounding the colostomy. On February 5th, 1943, the mass was excised and the colostomy refashioned. The pathologist reported the tumour to be benign fibromatous lesion with local involvement of the layers of the abdominal wall. The second patient reported by Cattell and Wiedman was a girl who, at the age of 12 years, in 1944, had colectomy and ileo-sigmoidostomy for multiple polyposis. In 1948 when 16 years of age she had a laparotomy for adhesions obstruction. In 1950, at 18 years of age, a firm nodule was found in the abdominal wall beneath one of the incisional scars; a biopsy established the diagnosis of desmoid.

These authors felt there was no evidence available to show that desmoids were more frequently observed in polyposis and expressed the view that their cases were probably incidental.

In 1955 Weiner and Cooper gave an account of four brothers with polyposis. In Case 1, in 1943 and at the age of 16 years, operations had been performed for tumours of the mandible, temporo-mandibular joints, third rib and for another behind the right ear. In 1952, at the age of 34 years, he presented with a carcinoma of the rectum and familial polyposis. On the 13th March, 1952, an abdomino-perineal excision of the rectum and sigmoid colon was performed. On the 16th April, 1952, the colectomy was completed through a transverse epigastric incision. In January, 1954, he was re-admitted with a lump 6 cm. in diameter and situated deep in the abdominal wall under the line of the transverse incision in the epigastrium. This was excised at operation and examination of the specimen histologically showed it to be a fibroma. In the second brother familial polyposis was discovered at the age of 30 years, and on the 27th March, 1953, ileostomy and subtotal colectomy were performed. On the 18th May, 1953, abdomino-perineal excision of the rectum completed the excision; a carcinoma was found in the sigmoid colon. In July, 1954, he required an emergency operation for perforated gastric ulcer and at the time of this operation a firm mass 6 cm. in diameter was palpable in the lower end of one of the healed abdominal incisions. It did not extend into the peritoneal cavity.

In the same year, O'Brien and Wels (1955) reported three further cases. Their first case was a male of 23 years of age who was admitted with carcinoma of the rectum and multiple polyposis. An abdomino-perineal excision of the rectum was performed. Two years later a tumour mass developed in the fascial planes of the abdominal wall around the colostomy stoma. He died two years and four months after operation (no cause given). Autopsy showed a tumour mass, 15 x 7 x 5 cm. and histological examination showed typical desmoid tumour. The second case, a female of 36 years, was subjected to staged resection for carcinoma of the sigmoid colon complicating multiple polyposis. Six months later a tumour mass developed in the fascial planes of the lower abdominal wall. It was resected several years later when it measured 16 x 8 x 8 cm. The histological report indicated typical desmoid tumour. The third case, a male 61 years, was subjected to right hemicolectomy on the 22nd September, 1949, for carcinoma of the caecum complicating multiple polyposis. On October 2nd, 1950, a tumour was discovered at laparotomy invading the mesentery adjacent to the previously established ileotransverse colostomy. It was removed and found to be benign fibrous tissue. In March, 1952, a tumour mass developed in the fascial planes of the abdominal wall adjacent to the upper third of the surgical incision. Biopsy showed it to be benign fibrous tissue. Both O'Brien and Wels (1955) and Weiner and Cooper (1955) intimated that the development occurred more frequently than could be explained by chance occurrence.

In 1958 Shepherd reported a further case. A female of 26 years presented with multiple polyposis of the colon, and in January, 1956, a subtotal colectomy and ileorectal anastomosis was performed. One year later she reported a tender swelling about the size of a hen's egg in the left lower paramedian scar. This was situated in the rectus muscle and unattached to the skin. A diagnosis of desmoid tumour was made. In May, 1957, it had increased in size; there was extreme tenderness to the right of the umbilicus and an abdominal mass was suspected. At operation the superficial tumour was found to lie in the rectus muscle; histological examination showed a diffuse fibromatous lesion characteristic of a benign fibroma. Shepherd studied the literature and found that desmoid tumours tended to occur in or near the scars after colectomy for polyposis and indicated that the incidence was appreciable.

The most recent report is that by Smith from the Mayo Clinic (Smith, 1958, 1959). In an article entitled "Desmoid Tumours in Familial Multiple Polyposis", he records an investigation into the case records of 201 patients with familial polyposis, seen at the Clinic during the twenty-three-year period from January, 1933, to January, 1956. Of these cases, approximately 150 who had surgical treatment survived long enough, or were observed for a sufficiently long period for a tumour of fibroblastic origin to develop in the scar. Nodules or masses associated with the incisional scar were subsequently observed in 8 of the 150 patients. In 6 of the

8, a diagnosis of desmoid tumour was made after tissue sections had been examined microscopically. The first patient was a female of 38 years who had developed large desmoid tumours in multiple sites in the abdominal incisions two years after a staged removal of the colon. The second patient had a staged operation for multiple polyposis at the age of 13 years. At 16 years, a large desmoid was found in one of the abdominal incisions. A third patient had a staged operation for polyposis when aged 44 years; one year after this was completed a desmoid tumour, 3.5 cm. in diameter was excised from the scar of the incision employed at the time of the colectomy. The fourth case was a man of 60 years who had a staged operation for polyposis. One year later a desmoid tumour was removed from one of the abdominal incisions. A fifth patient, a man of 49 years, developed a desmoid tumour in the scar two years after colectomy. The sixth case was a 21-year-old woman who developed the desmoid tumour one year after operation; it was 3 cm. in diameter and was removed from the previous abdominal incision.

To these 16 cases that have appeared in the literature a further case is added here.

FIG. I. The desmoid excised from the right scapula region in 1953 shows densely compacted structure of wavy collagen bundles arranged in parallel strands in some parts and irregularly in others.

CASE REPORT

Miss J. A. W., aged 24 years, was referred on the 5th July, 1956. For eighteen months she had suffered from diarrhoea, and the passage of loose motions. She averaged from 3 to 5 bowel actions daily but her sleep was not disturbed. On occasions for about three months prior to the consultation she had observed blood in the motions. Her general health was good and she was employed in a secretarial post.

Previous history

In 1953 she had had a lump, thought to be a low grade sarcoma, explored in the region of the right scapula. The surgeon stated that the lump, macroscopically, was a peculiar mass of fibrous tissue infiltrating the muscles on the dorsum of the scapula. Histological examination revealed a densely compacted structure of wavy collagen bundles in some parts arranged in parallel strands, in others running in many directions (Fig. I). The most characteristic feature of the lesion was the diffuse involvement of the adjacent intramuscular septa which were thickened and appeared to be encapsulating the nearest muscle bundles, and in parts even individual muscle fibres, with this dense collagenous tissue continuous centrally with the tumour mass (Fig. II). The tumour was sparsely populated with fibroblasts which were distributed fairly evenly along and parallel to the collagen fibres. There were no localized foci of active fibroblastic hyperplasia. The pathologist (Dr. G. Harkins) considered the lesion to be a desmoid tumour.

FIG. II. The most characteristic feature is the diffuse involvement of the intramuscular septa which are thickened and appear to encapsulate the nearest muscle bundles.

Family history

Her father died at the age of 32 years from carcinoma of the (?) pancreas. He had familial polyposis and subcutaneous lesions but the nature of these is not known. Her mother was free from bowel trouble. Her brother had osteomas and superficial lumps but it had not been possible to examine him with a sigmoidoscope. Her grandmother died when she was over 90 years of age: her grandfather died during an operation on his (?) gall-bladder. Her father had six sisters but all have been free from trouble (Fig. III).

Physical examination

There was an ill-defined lump about three centimetres in diameter in the neck posteriorly, immediately to the left of the 5th cervical spinous process, closely related to the ligamentum nuchae. There were four other ill-defined lumps of about the same size close to the spine and opposite the spinous processes of T10, T11, L2 and L4 respectively. There was a similar lump further lateral and just below the 12th rib on the right side. Under

a healed oblique incision placed over the right scapula was a diffuse mass about 6 cm. in diameter not attached to skin, but apparently in the fascia covering the infraspinatous muscle (Fig. IV). She had a small osteoma of the left zygoma just anterior to the glenoid fossa. There was some fullness of the abdomen. Palpation within the rectum revealed multiple polyps and this was confirmed on sigmoidoscopic examination. A barium enema examination on the 20th June, 1956, by Dr. Reginald Crisp showed the presence of polyps in the remainder of the colon.

Progress

She was kept under observation and from time to time polyps were fulgurated in the rectal stump. The anastomosis was well visualized at 12 cm. from the anus. She had from two to six bowel actions daily and was engaged in full work. On the 25th June, 1958, a large haemorrhoid was removed under anaesthesia and three polyps were fulgurated. The scar was tender and showed some induration but no undue concern was felt about it.

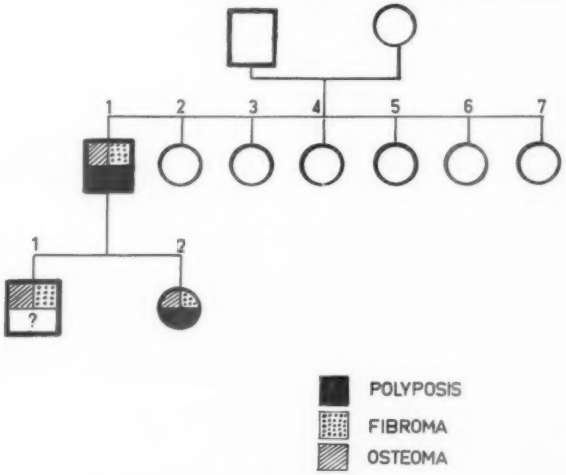

FIG. III

Treatment

She declined treatment for a time but finally agreed to operation. At several sessions the rectum was cleared of polyps by fulguration. She was then admitted to the Royal Melbourne Hospital and on the 11th June, 1957, through a left paramedian incision, a colectomy and ileo-rectal anastomosis was performed. Her convalescence was uneventful and she left hospital on the ninth post-operative day. Examination of the colon (Fig. V) by Dr. J. D. Hicks showed multiple polyposis but no evidence of malignancy.

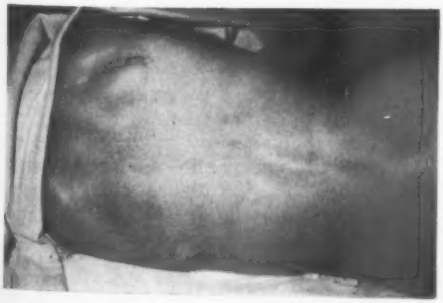

FIG. IV. Mass visible under oblique wound placed over the right scapula.

On the 5th November, 1958, she attended for review and on this occasion there was no doubt concerning the presence of a mass in the scar of the paramedian incision (Fig. VI). The mass extended from the level of the umbilicus to the pubis, and from the middle line to 3 cm. lateral to the wound, to give an overall size of 10 x 5 cm. It was hard to estimate the depth of the mass, but it appeared to be 4 or 5 cm. The skin was mobile over it except along the line of the incision scar. The mass was movable with the abdominal wall but was fixed when the muscles were tensed. It was hard, slightly granular, fairly well defined, and a little tender. Portion of the proximal end of the wound above the umbilicus was not involved. Although there was no evidence of carcinoma in the colon it was thought nevertheless, that the mass was a carcinoma from implantation. A biopsy was performed under local anaesthesia on the 15th November, 1958. Microscopic examination showed a structure identical to that of the scapula desmoid with the same densely packed wavy collagenous structure continuous with similar changes extending along the intramuscular septa, isolating muscle bundles and fibres which in the deeper parts of the tumour appeared to be necrotic and showing various phases of nuclear damage up to necrosis (Fig. VII).

On the 31st March, 1959, she reported with severe pain in the left flank. This had been present for two weeks and extended from the level of the 12th

thoracic vertebra down to the 3rd lumbar and radiated forward under the left costal margin. The pain had been severe enough to disturb her sleep for a week but she had continued to work. Examination showed the paramedian wound tumour to be unchanged, but there was now a mass palpable under the left costal margin, within the peritoneal cavity and generalized distension of the abdomen. After a period of observation in which the abdominal pain and distension persisted a laparotomy was performed.

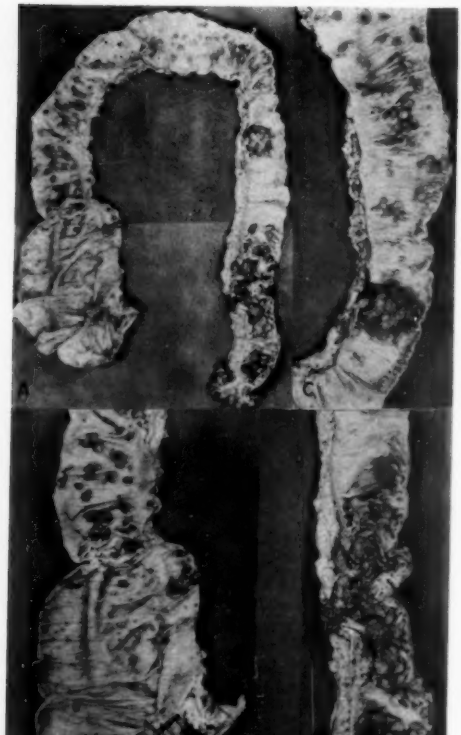

FIG. V. The colon removed for familial polyposis on the 11th June, 1957.

Second operation

On the 8th May, 1959, a long left paramedian incision was made. This incision extended into the old left paramedian wound and included not only the upper part that was clinically normal but also portion of the lower containing the fibromatous mass. This latter was dense white and homogenous and involved the aponeurotic anterior and posterior sheaths of the rectus muscle (Fig. VIII). In the upper, non-indurated portion of the scar there were, in the posterior sheath, small nodules of fibrous tissue. These were more vascular on the surface and not so firm on section as the more mature fibrous tissue in the distal part of the wound. In the upper portion of the incision which had not been opened previously the tissues were normal. Within the abdomen there were numerous carcinomatous nodules on the peritoneal surface and within the liver. There was a large mass in the region of the pancreas. In the mesentery of the small intestine was a dense white hard area which appeared firmer and less friable than the carcinomatous material. Portions of the various masses were examined microscopically. That from the incision was composed of fibrous tissue similar to that observed in the biopsy. The tissue in the mesentery of the small intestine possessed a loose collagen network, roughly arranged in parallel bands but of no distinctive pattern; it was a little more cellular than the skeletal desmoid and showed more vascular spaces (Fig. IX).

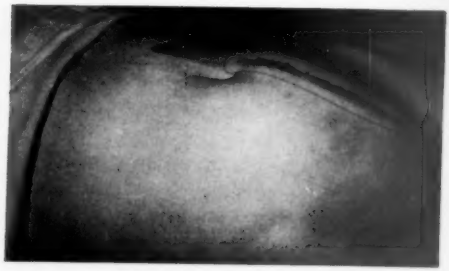

FIG. VI. The mass in the lower two-thirds of the left paramedium wound is outlined with skin pencil.

The overlying peritoneum contained in the subserosal plane a faint staining mucoid deposit. The remainder of the biopsy material was malignant and was described as "carcinomatous, possibly of pancreatic origin". The rectal stump was re-examined and was found to be clear of polyps.

Final progress

Her condition deteriorated and she died on the 1st June, 1959. No autopsy was obtained. The origin of the final overwhelming malignancy was never determined.

DISCUSSION

The tumour masses developing in the abdominal scars of polyposis patients have been termed "desmoid" tumours in most reports. The word "desmoid" (meaning tendon-like), introduced by Johannes Mueller in 1838, refers to dense masses of fibrous tissue developing spontaneously, mostly in the abdominal wall and occasionally after trauma, particularly surgical; the masses have no capsule, show a preference for fascial planes, and incorporate the muscle fibres at their edge. Histologically the appearances vary from a relatively acellular fibroma to that of a low-grade fibrosarcoma. In one of the polyposis cases (that reported by Miller and

Sweet, 1937) the histological diagnosis was fibrosarcoma but in the remainder the diagnosis was either desmoid or fibroma.

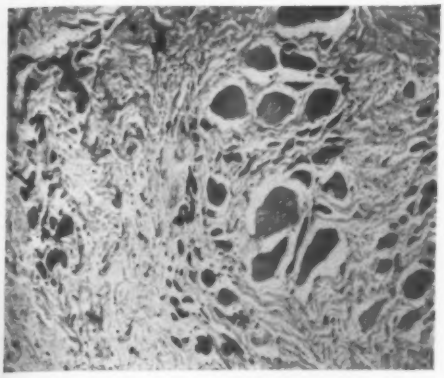

FIG. VII. Biopsy of the wound desmoid in 1958 showed the same densely packed collagenous structure, continuous with similar changes extending along the intramuscular.

The arrangement of the collagen bundles was far more irregular than is usual in the fibroblastic lesions of those plantar, palmar or penile fibromatoses, often grouped as the "desmoplastic" or Dupuytren's diathesis and there were no foci of active fibroblastic hyperplasia. Further, the total absence of inflammatory cells seemed to refute the possibility of an origin from granulation tissue.

Desmoid tumours are rare. Pack and Ehrlich (1944) found 17 desmoid tumours of the abdominal wall at the Memorial Hospital and during the period under review (1917-1943) there were 50,346 cases of neoplastic diseases admitted to hospital. None of their cases occurred in a laparotomy wound. However, others have reported such cases from time to time. Stewart and Mouat (1924) reviewed 59 cases of abdominal wall fibroma from the literature and added seven of their own. Five occurred in abdominal scars. Burnell (1951) reported a large desmoid tumour in an upper right paramedian wound through which the gall-bladder had been removed. Karshmer and Barbano (1951) observed a large desmoid tumour in the abdominal scar after removal of a right ovary, tube and appendix. However, the repeated appearance of case histories of familial polyposis in which desmoid tumours have appeared in the abdominal incisions suggests that the association is hardly fortuitous. Smith (1959) found an incidence at the Mayo Clinic of just over three per cent. following operations for multiple polyposis.

FIG. VIII. The fibromatous mass in the lower end of the laparotomy wound.

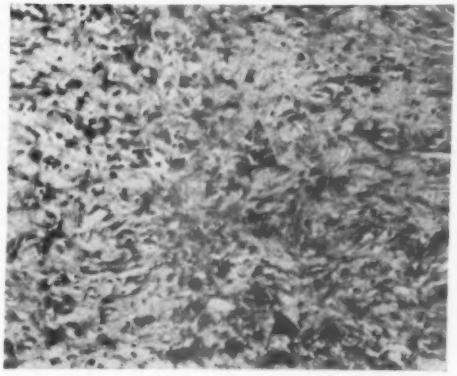

FIG. IX. The mesenteric fibroma possesses a loose collagen network, roughly arranged in parallel bands. It is a little more cellular and more vascular than the scapular and wound desmoids.

In 7 of the 17 reported cases of desmoid tumour in polyposis cases osteomata of the maxilla or mandible, sebaceous cysts and fibromas have been present prior to surgery or were observed when special search was made after the patient returned with desmoid tumour. In the remaining 10 cases there were no manifestations of this peculiarity. In some of these cases it may not have been thought relevant to include such information but nevertheless it seems certain that some patients without lesions elsewhere can develop desmoid tumours in their wounds. In the

authors' case the scapular desmoid and abdominal scar mass showed an identical structure. The mass in the mesentery of small bowel showed a related microscopic appearance.

Gardner and his colleagues (Gardner *et alii*, 1951, 1952, 1953) studied the pattern of inheritance for surface tumours and found they conformed to that of a simple dominant gene. These investigators suggested that the co-existence of benign surface tumours and polyposis might be more than a coincidence.

The genetic association of different abnormalities is not unique, e.g. the Lawrence-Biedl-Moon syndrome, neuro-fibromatosis and cafe-au-lait patches, and gastro-intestinal polyposis and melanin pigmentation. In view of the appearance of geographically separated families and apparently unconnected it is unlikely that two closely linked separate genes are responsible. A single defective pleotropic gene (a gene with multiple primary actions) is an alternative explanation which, however, is not favoured generally. It is possible that the mutant gene has but a single action although many steps removed from any clinically obvious manifestations. This explanation seems the more probable in view of the frequency with which these fibrous tumours occur in different sites in the same individual, i.e. subcutaneous, intra-abdominal and in the wound.

In the cases reported in the literature the desmoid tumour has appeared in the abdominal incision, and, as a rule, after the completion of treatment of polyposis. In two cases the appearance of the desmoid tumour was delayed until after a subsequent laparotomy, performed after completion of the colectomy. In a third case the desmoid was first observed eighteen months after removal of a mesenteric fibroma. In all but one case the tumour appeared within two years of the operation.

In 13 of the 17 cases the tumour was excised. One died on the 8th post-operative day (a mesenteric fibroma was also removed). In six of the 12 surviving cases there was no follow-up study. In three the tumours recurred after excision, and in one of these 4 excisions were performed in ten years. One of these three patients with recurrence was treated by irradiation and two by further excision but final follow-up examinations have been incomplete. One patient (Cattell and Wiedman, 1952) was free from recurrence nine years after excision, another (Smith, 1958) was free from recurrence eight years after and a third (Smith, 1958) one year after excision.

In 4 of the 17 reported cases the desmoid was not excised. In one treatment was deferred; a second patient succumbed prior to surgery; in a third a biopsy was performed only. No follow-up information was available concerning the two survivors. In the fourth patient (reported here) abdominal carcinomatosis was responsible for the death of the patient six months after the tumour was first observed. In this time there was no increase in size of the mass. There were several reasons for not advising excision in this case. First, the histological appearances were identical with the fibrous mass in the scapula region and this had not shown any significant alteration in size for several years; secondly, the wound desmoid showed no change from month to month; and thirdly the recurrence rate after excision appeared to be formidable in the literature.

The review of the literature and of the case history of the patient reported here shows that there is a tendency for patients with familial polyposis to exhibit abnormal tissue overgrowth in the form of osteomata, fibromata and sebaceous cysts. An additional manifestation is excessive fibrous tissue overgrowth in the operation scars in the abdominal wall.

SUMMARY

Familial polyposis is associated sometimes with an abnormal behaviour in certain other tissues. Osteomata, soft tissue tumours, sebaceous cysts and intra-abdominal fibrous tissue masses may co-exist with familial polyposis.

A case is recorded in which a desmoid tumour appeared in the wound after surgical treatment of familial polyposis. This is the 17th case to be reported in the literature.

Pathologically, the tumour appears to be histologically distinct from palmar and plantar fibromatosis nor does it seem to be inflammatory in origin.

Desmoid tumours in surgical incisions are rare but the number that have been reported in familial polyposis seems to indicate that in this disease there is a special tendency.

The desmoid tumour may or may not be associated with fibrous tissue masses and osteomas elsewhere. In the case reported here these were present. It is known that this latter abnormality is transmitted as a Mendelian dominant. The curious association with polyposis has suggested two closely linked genes, or a pleotropic gene; a more acceptable theory is that the mutant gene has but a single action many steps removed from any clinically obvious manifestations.

Recurrence after removal is so common that it seems excision should be very wide, to avoid the involved fascial sheets. The prognosis of these desmoids has not been established and it is possible that removal is not essential.

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ATRIAL SEPTAL DEFECT*†

SIGNIFICANCE, PHYSIOLOGICAL AND CLINICAL ASPECTS

By H. A. Fleming

Hallstrom Insitute of Cardiology, Royal Prince Alfred Hospital, Sydney

THE clinical features of atrial septal defect were well described by Bedford, Parkinson and Papp in 1941. This is the commonest form of congenital heart disease seen clinically and accounted for 18 per cent. of Wood's series reported in 1956. The anatomical features of this defect vary considerably and have been fully dealt with by various writers (Wakai and Edwards, 1956; Bedford *et alii*, 1957).

In the past this defect has been regarded as benign and this tendency is still seen in the reporting of single cases that have reached an advanced age. These cases in no way alter the general prognosis. After infancy the prognosis is good for a somewhat reserved type of life until the age of 20. It is moderately good till the age of 30, but thereafter steadily deteriorates and the average age of death is from 35-39 years (Campbell *et alii*, 1957). The onset of atrial fibrillation frequently causes more rapid deterioration. Such an outlook must be remembered in considering repair of the defect.

Death is commonly due to right heart failure without any preceding rise in the pulmonary vascular resistance. In about 10 per cent. of the cases there is a rise in the pulmonary vascular resistance which occurs much later in life than is common in ventricular septal defect, and is probably largely due to the endarteritic changes secondary to a large pulmonary blood flow (Wood, 1958; Dexter, 1959). This process may be suddenly accentuated by episodes of pulmonary artery thrombosis. A rise in the pulmonary vascular resistance will cause diminution in the left to right shunt and will eventually lead to shunt reversal.

Bacterial endocarditis is rare, occurring in less than one per cent. of patients. It should suggest a co-existing pulmonary valve stenosis.

Haemodynamics

The defect in the atrial septum is commonly large; 4 cms. in diameter being an average figure. Through this hole blood shunts freely from the left to the right atrium. The pressures in the two atria are virtually the same, though with special methods of investigation it is possible to demonstrate that in different phases of the cardiac cycle the pressure relationships of the two atria change (Wood, 1958). In these circumstances out-flow from the virtually common atrium depends on the filling resistances of the two ventricles (Dow and Dexter, 1950; Dexter, 1956). As the right ventricle in the adult is thinner than the left it offers considerably less resistance to filling. Thus in each cardiac cycle much more blood enters the right ventricle than the left. This leads to a pulmonary blood flow that exceeds the systemic blood flow by three times, or even more. This flow is ordinarily associated with a normal or low pulmonary vascular resistance. It might be thought that this left to right shunt would reduce the output of the left ventricle, but this has not been found to be so at rest (Weidman *et alii*, 1957). It is likely that the output is restricted on exercise. The blood pressure tends to be low (Campbell *et alii*, 1957). The pumping of this large volume of blood by the right heart leads to the symptoms and the characteristic physical signs. To a person unfamiliar with cardiology these may not be evident and they are often overlooked until adult life. This is because the symptoms are frequently vague and the defect is not usually

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associated with loud murmurs which would draw attention to it. Cases present in the following ways:

1. On routine examination.
2. On routine radiography.
3. With symptoms.

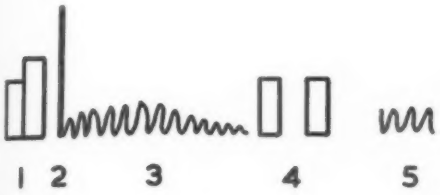

FIG. I

1. Loud tricuspid first sound.
2. Pulmonary systolic ejection click.
3. Pulmonary systolic flow murmur.
4. Wide, fixed split of the second heart sound.
5. Tricuspid diastolic flow murmur.
6. Infrequently pulmonary diastolic murmur of pulmonary incompetence.

EXAMINATION

The patient is frequently small and slender and may have arachnodactyly. The pulse is of a small normal character and the jugular venous pulse is normal. The right ventricle is felt to be hyperkinetic and there is an increased amplitude of pulsation over the pulmonary artery. The auscultatory signs were well described by Leatham and Gray in 1956 and are graphically represented in Fig. I. All these features are due to the excessive flow through the right heart. The accentuated tricuspid first sound is caused by the continued filling of the right ventricle throughout diastole so that at the onset of ventricular systole the tricuspid leaflets are widely separated and close with increased force. The pulmonary systolic click is due to the ejection of the large right ventricular stroke volume into the dilated pulmonary artery. The pulmonary systolic murmur is caused by the large flow across the pulmonary valve. The wide splitting of the second heart sound is due to delay of the pulmonary element resulting from the long ejection period of the right ventricle. The fixed nature of the split is caused by lack of change in right ventricular filling between inspiration and expiration as this is already maximal. It is rather more difficult to explain why this behaviour does not revert to normal immediately following successful repair of the defect but takes from two days to three weeks or even longer. The tricuspid diastolic murmur is due to the torrential flow through the tricuspid valve, a mechanism similar to that producing a mitral diastolic murmur in patent ductus arteriosus and ventricular septal defect. A pulmonary diastolic murmur occurs uncommonly in the absence of pulmonary hypertension.

The electrocardiogram shows a degree of right bundle branch block in most cases (60-95 per cent. in different series). This is not a true bundle branch block but is due to hypertrophy of the outflow tract of the right ventricle as a result of the large volume load (Blount *et alii*, 1957). Further information gleaned from the electrocardiogram will be mentioned later. Atrial fibrillation occurs relatively late.

Radiology

The radiological features are pulmonary plethora with increased pulsation of the vessels when viewed fluoroscopically. There is enlargement of the right atrium, right ventricle, the main pulmonary artery and both its branches. The aorta is small. The presence of anomalous pulmonary veins may be suggested by a dilatation of the superior vena cava at the point where the veins enter it or by abnormal vascular shadows representing the veins themselves.

SYMPTOMS

Symptoms are listed below.

1. Tiredness and lack of energy.
2. Breathlessness on exertion.
3. Recurrent chest infections.
4. Palpitations — due to supraventricular arrythmia.
5. Later congestive heart failure.
6. Ignorance of normality until the benefit of repair of the defect is felt.
7. Less commonly syncope, angina, haemoptysis.

Their non-specific nature is striking. They are often dismissed as "functional." Many of these patients do not realise what symptoms they have till the defect is repaired. It is common for them to say, "I did not realize

that I had been tired and breathless all my life until now." Even a "symptom-free" patient may only be claiming this lack of disability because he knows no better state. This is important. Syncope is associated with arrhythmia (Papp, 1958). Angina suggests co-existing coronary artery disease. Haemoptysis is due to pulmonary artery thrombosis.

In atrial septal defect the right heart is working under a great burden and the chance of a normal life is quite limited. One would advise repair in all cases where this can be safely achieved. There are no absolute contraindications to surgical treatment and each case must be considered on its merits. Extremely good results can be obtained in almost derelict cases. However, advancing age, great cardiac enlargement, heart failure and elevation of the pulmonary vascular resistance or systemic hypertension will all increase the surgical risk.

The ostium secundum type of defect with a large pulmonary blood flow and a normal pulmonary vascular resistance is so straightforward that there is little reason for cardiac catheterization unless to search for anomalous pulmonary veins. What further facts can the cardiologist demonstrate both for his own benefit and that of his surgical colleagues?

(1) We may demonstrate that there is an atrial septal defect. This is important where the left to right shunt is small and there is evidence that there are multiple anomalous pulmonary veins draining from the right lung. In such circumstances there may be hemi-anomalous venous drainage without an atrial septal defect. If the catheter is passed across the atrial septum and there is no more than a small pressure drop across it (eliminating patent foramen ovale), this is good evidence that there is a defect. The route taken by the catheter is not of great assistance in deciding the anatomical nature of the defect. An exception to this is the sinus venosus type of defect where anomalous venous drainage of the right upper lobe into the superior vena cava is associated with a high small defect. A low passage of the catheter into the left ventricle is not evidence for an atrioventricular canal defect, unless it passes into the aorta.

Another method of proving the defect is an application of the Valsalva manoeuvre introduced by Lee and Gimlette in 1957. During the period of straining the venous return to the right atrium is arrested and the cardiopulmonary blood volume is reduced. At the end of the period of straining the left atrium is relatively empty and venous blood rushing back to the right atrium spills across the defect for a short time. The spill is reflected as a transient drop in arterial oxygen saturation which can be recorded by an ear oximeter.

(2) We may measure the level of the shunt, the magnitude of the flow and the pulmonary vascular resistance. These can be achieved by sampling and pressure measurement at cardiac catheterization. If, in repeated sample runs, an increase in saturation is found at ventricular level in addition to atrial level, an atrio-ventricular canal defect may be suspected.

McIlroy (1958) has demonstrated that the size of the shunt can be judged approximately by the response to the Valsalva manoeuvre. If the response is normal, showing a drop in pulse pressure and followed by an "overshoot" with bradycardia, the pulmonary to systemic blood flow ratio is less than 3.5 to 1. At higher flow ratios the response is of the "square wave" type (Sharpey-Schafer, 1955). These two responses can be clinically distinguished by noting the bradycardia in the normal response. In those patients with a "square wave" response, the shunt reversal described above will not occur. It may be encouraged by increasing the venous return by exercise or by raising the legs (Lee and Gimlette, 1957).

(3) We may demonstrate the type of defect. There are three important anatomical types which require different surgical techniques for their repair. A precise diagnosis should therefore be made before surgery.

The sinus venosus defect has already been mentioned. In the ordinary ostium secundum defect dye injection into the inferior vena cava often shows a small right to left shunt. The sinus venosus type also shows this effect but only if dye is injected into the superior

vena cava (Swan *et alii*, 1957). The reason for this can be seen in the case anatomical relationship of the inferior and superior venae cavae respectively to these defects.

The third type is the atrio-ventricular canal defect in its various degrees (Wakai and Edwards, 1958). This is associated with a high mortality in early life and a much higher incidence of pulmonary hypertension than the secundum defect. In this type, in addition to the signs already described, there may be those of mitral regurgitation. However these are frequently lacking and the most useful indication is given by the electrocardiogram. Whether this shows left axis deviation in the standard leads an atrio-ventricular canal defect must be suspected (Toscano-Barboza *et alii*, 1956). Vector-cardiography confirms this situation (Hamer, 1958). This type of QRS complex appears to be associated with the path of the conducting bundle and is not related to mitral regurgitation. A prolonged P-R interval is also common. Left axis deviation is found in 7 per cent. of ostium secundum defects (Toscano-Barboza, *et alii*, 1958) and there may be no means of distinguishing them. Where an efficient cardio-pulmonary by-pass machine is available it is better to use it unnecessarily on a few patients than to fail to diagnose an atrio-ventricular defect and submit the patient to two thoracotomies. Until recently we had thought that the demonstration of anomalous pulmonary veins was strongly against the diagnosis of atrio-ventricular defects. Wakai and Edwards (1958) reporting 28 cases of atrio-ventricular defect recorded no such anomalies. Correspondence with Dr. Edwards confirmed that they had not seen this combination. However we have recently found a case of atrio-ventricular canal defect with anomalous drainage of the right upper lobe into the superior vena cava. A final differentiating point is that in the posteriorly situated ostium secundum defect, dye injections into the pulmonary arteries show that much more blood from the right lung shunts across the defect than from the left lung (Swan *et alii*, 1956). This is shown in the striking difference between curves from the right and left pulmonary arteries. An observation that may be related to this is the demonstration that considerably more blood may flow through the right lung than the left (Fleming, 1959). This can frequently be suspected from the radiograph and it may also be reflected in the larger bulk of the right lung when seen at bilateral thoracotomy. In the lower and more anteriorly situated atrio-ventricular canal defects mixing of the blood in the left atrium is much more complete and there is little preferential shunting of blood from the right lung. This is shown by the similarity of dye curves from the right and left pulmonary arteries. This may be a helpful point in the differential diagnosis from ostium secundem defect (Wakai, Swan and Wood, 1956).

(4) We may demonstrate anomalous pulmonary veins. This diagnosis must be made with caution. Careful and repeated sampling will detect veins entering the venae cavae. Judged from the path of the catheter it is only possible to be certain about these when they enter above the right atrium. When they enter the right atrium itself it is impossible to tell whether the catheter has first crossed the atrial septum before entering the right pulmonary vein. Till this fact is realized anomalous pulmonary venous drainage will be much too frequently diagnosed.

The actual path of drainage of veins can be demonstrated by dye injections into them and comparison with curves made by injections into the superior vena cava and the left atrium. Total anomalous venous drainage of the right lung without an atrial septal defect is associated with very different curves resulting from dye injections into the right and left pulmonary arteries. The left pulmonary artery curve is normal but the right pulmonary artery curve has a very long appearance time followed by a slow down-slope due to recirculation through the lung. The curve is flat due to the large volume of blood between injection and sampling points.

A left-sided superior vena cava may be demonstrated on the radiograph or at catheterization. Such information is helpful in planning inflow occlusion.

(5) We may assess associated pulmonary valve stenosis. This again has been too frequently diagnosed. It occurs in perhaps 10 per cent. of atrial septal defects. Where it is significant the signs of pulmonary stenosis tend to dominate those of atrial septal defect. The pulmonary systolic murmur is longer

and is accompanied by a thrill. The pulmonary second sound is even more delayed and is diminished. There are two reasons for the false frequency of this diagnosis. First, at high rates of flow across a normal pulmonary valve a pressure fall occurs. The height of this pressure fall rises as the flow increases (Weidman *et alii*, 1957). Second, in the main pulmonary artery with high velocity of flow. there may be a systolic fall in pressure, apparently indicating a considerable pressure gradient, due to the Venturi effect. A more reliable pressure tracing may be obtained in a peripheral part of the pulmonary vascular tree or from the wedged pulmonary vein position (Wood, 1956). With a large flow a systolic pressure gradient of less than 40 mm. Hg. is of no significance. In doubtful cases the pressures in the right ventricle and the pulmonary artery should be measured at thoracotomy before and after repair of the defect. In most cases no significant gradient remains. If a significant gradient is found pulmonary valvotomy is then performed.

(6) We may assess Lutembacher's syndrome or atrial septal defect with mitral stenosis. This has been too frequently diagnosed and in fact rarely occurs; certainly in no more than 5 per cent. of atrial septal defects. Clinical diagnosis can be difficult as the whole anterior surface of the heart is occupied by the right ventricle and mitral signs may be obscured. Diagnosis at catheterization is also difficult unless a withdrawal tracing across the mitral valve is obtained. Fortunately, provided left ventricular failure can be excluded, this is of little importance, as good surgical practice includes exploration of the mitral valve through the defect. Mitral valvotomy can be carried out by that route when stenosis is found.

Results of Surgery

Surgery restores the circulation to normal and we imagine gives the patient a normal life expectancy. We are certainly taking that attitude for the purposes of employment and superannuation. There is good evidence for this. Immediately the defect is repaired the pressure relationships between the two atria become normal (Pemberton *et alii*, 1957). Subsequent catheterization shows normal findings in all respects. It had been imagined that after repair of the defect the left ventricle might have difficulty in coping with its unaccustomed volume load. The clinical course and the measurements already mentioned show that this is not so. Exceptionally in cases of severe systemic hypertension left ventricular failure has occurred (Pemberton *et alii*, 1957).

Residual auscultatory signs are related to the dilated pulmonary artery. These are the ejection click and possibly the systolic ejection murmur. The other signs all disappear. The restoration of the second sound to normal may be delayed. Radiologically the pulmonary plethora regresses and in time the heart size decreases.

This short survey does not permit a detailed discussion of pulmonary hypertension. Before operation this must be carefully assessed. Where the pulmonary vascular resistance is less than 10 units and the shunt flow greater than 2 : 1 most cases are operable. However the risk is greater and the final result less satisfactory.

Gross cardiac enlargement will probably never revert to normal. Ideally repair should be carried out before the age of 20 years and before much cardiac enlagement has occured. The patient is then sent away with no greater abnormality than a thoracotomy scar.

Summary

The clinical and physiological features of atrial septal defect are reviewed.

The prognosis for patients with this defect is quite limited and ideally repair should be carried out before adult life.

Associated anomalies that may occur are detailed and their assessment described.

Surgery restores the circulation to normal and gives symptomatic improvement. Improvement may also be noted by patients with no spontaneous complaints.

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ANTERIOR TIBIAL ARTERY OCCLUSION AND RELATED SYNDROMES*

By B. VENNER

Adelaide

INVOLVEMENT of the anterior tibial artery in vascular disease has not received much attention in the past. It is not specifically mentioned by such well-known writers as Samuels (1956) or Allen Barker and Hines (1946). Martin, Lynn, Dible and Aird (1956) refer to the "anterior tibial syndrome", and experienced surgeons are aware of the "arterial" ulcer which occurs on the front of the leg, accompanying peripheral arteriosclerosis obliterans (Sirbu, Murphy and White, 1944).

The manifestations of peripheral vascular disease are commonplace, and the acute episode occasioned by peripheral embolism or thrombosis is a conspicuous and well-known clinical entity. The sequence of sudden pain, loss of function, and coldness of a limb is readily diagnosed; and usually the occlusion can be localized to its site in a major vessel. On occasion, the transient or fluctuating nature of the physical signs introduces a confusing element; the patient with an obvious major arterial occlusion may, in a relatively short space of time, secure a rapid and apparently complete return of circulation. Such cases may be due to the rapid and efficient establishment of a collateral circulation, to relief of an arterial spasm, or to the fragmentation of a thrombus and its dissemination to smaller and less significant vessels. It is usual, however, for a residue of ischaemic manifestations to remain when an organic occlusion has been present in such a case.

Acute occlusion of the anterior tibial artery produces a characteristic syndrome, but one which may cause some confusion. There occurs an acute ischaemia, not of the whole limb, but of the anterior tibial compartment and the overlying skin, and the issue may range from massive gangrene of the region, through fibrous contracture, to complete recovery.

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In the first case to be described, the whole of the leg was ultimately lost.

Case 1

M.F., a female, aged 43 years, was admitted on 30 March, 1957, with a history of sudden loss of consciousness, with gradual recovery after which she found that the right side of her body was paralyzed, and speech impaired. She had had rheumatic fever at 13 years of age and been told that she had some "rheumatic heart damage".

On examination, she was found to have a complete right hemiplegia, with aphasia, an auricular fibrillation requiring digitalization, and evidence of mitral stenosis. The blood pressure was 130/80 mm. of mercury. She was treated in standard fashion, including physiotherapy.

On the tenth day after admission, she made her attendants aware of pain in her left leg, especially below the knee. The leg was found to be colder than the right one, but no colour change was said to be present, although no pulses were felt. Early next morning, the left leg was of mottled appearance below the knee and the posterior tibial pulse was now felt. A surgical consultation was sought.

At this time, the left leg presented the appearance shown in Fig. I. The whole circumference below the knee was slightly dusky in colour and cooler than the right one, but there was, in addition, a conspicuous cyanotic area on the anterior aspect. The anterior tibial pulse was absent, but popliteal and posterior tibial pulsations were detected, the latter rather weaker than in the other leg. There was no apparent movement in the muscles of the leg below the knee, although co-operation was not readily obtained. There was some tenderness of the muscles.

Treatment along standard lines, with anticoagulants and vasodilator drugs was carried out. Pain remained a troublesome feature, and heavy medication was required. The subsequent course was complicated by an urinary infection, pneumonia and a severe staphylococcal abscess of the right buttock.

After three days, the area on the anterior aspect of the leg had become darker, with commencing vesication. The remainder of the leg was obviously viable and there was an erythematous flush around the discoloured area. The line of demarcation became progressively more definite in succeeding days and the skin of the ischaemic area became obviously necrotic.

A great deal of medical and nursing care was required in the next three weeks, to combat the infective complications, and the general condition was poor. On the twenty-seventh day, at operation under general anaesthesia, the whole contents of

the anterior tibial compartment were found to be necrotic and interspersed with pockets of thick yellow pus. The whole mass was excised readily, with very little haemorrhage, leaving an unpleasant wound (Fig. II). A small amount of pus escaped from an orifice in the interosseous membrane, but on incising this, the underlying muscle tissue appeared to be alive. The wound was packed with gauze soaked in eusol. A proteus vulgaris, sensitive to chloromycetin, was grown from this wound.

For three or four days, the general condition remained reasonably good and the large wound began to show some granulation, especially in the upper part. However, after three more days the foot had become dusky and cool and pain again became troublesome. The general condition became poor, and the temperature remained elevated at around 100°F. Preparation was then made to amputate the left leg under refrigeration anaesthesia.

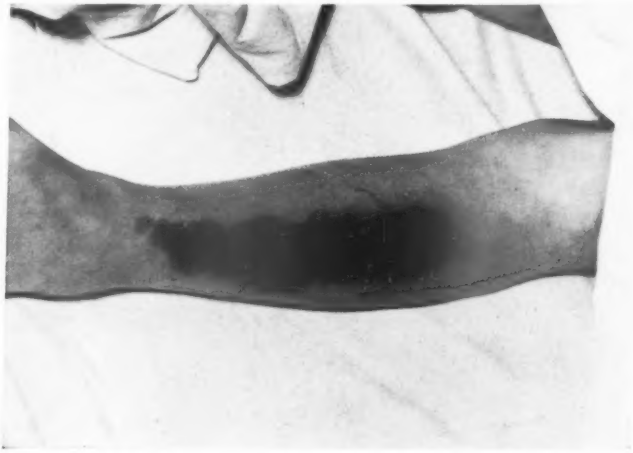

FIG. I. The irregular, elongated area of discolouration and incipient gangrene over the anterolateral aspect of the leg is surrounded by a well-developed erythematous zone.

At this operation, an amputation at the site of election in the thigh was carried out. The cutaneous and subcutaneous tissues of the dorsum of the foot were found to be gangrenous, but there was no gangrene in the muscles of the posterior part of the sole. Following operation, the stump healed readily.

The subsequent course was prolonged by further staphylococcal skin and urinary infections, which were finally overcome. With the aid of physiotherapy, she became able to walk with crutches, a pylon and a caliper on her right leg, and was finally discharged to her home on 24 Sept., 1957.

The preceding case would seem to present a reasonable diagnosis of embolic migration to the cerebral circulation, with subsequent embolism in the left leg. It is likely that a major embolus soon fragmented, with residual occlusion of the anterior tibial artery and probably of smaller vessels in the leg. Although there was some evidence of ischaemia in the leg generally, the bulk of the damage was manifest in the anterior tibial distribution.

The "anterior tibial syndrome" is also worthy of comment (Carter, Barham and Zachary, 1949) and (Sirbu, Murphy and White, 1944), and this diagnosis was for a while entertained in the case described. This is a condition, arising after some unaccustomed exertion, or on occasion after transfusion in the long saphenous vein, and due to ischaemia in the anterior tibial compartment. The condition begins suddenly as a painful, dusky red swelling on the upper anterior part of the leg, with induration, discoloration and sometimes the onset of foot drop and anterior tibial nerve palsy. Recovery may be complete, but commonly the changes of muscle fibrosis and atrophy are permanent, and the macroscopic and microscopic changes of ischaemia are observed. The condition is pathologically analogous to Volkmann's ischaemic contracture (Carter, Barham and Zachary, 1949). However, in the convalescent stage, arteriograms are said to be normal (Martin, Lynn, Dible and Aird, 1956), so that an organic occlusion cannot be present, and the exact aetiology is obscure.

Case 2 (reported by kind permission of Mr. A. C. McEachern)

A man aged 54 years was admitted one day after a vehicular accident, in which he was struck behind the left knee and on the front of the lower leg. The next morning he was unable to walk because of weakness of the knee, with swelling and numbness of the left leg. He gave a history of heavy drinking and bore the scar of a laceration behind the left knee, sustained some forty years before.

Examination revealed that the pulse rate was 102 per minute and blood pressure 135/85 mm. of mercury. The left leg was very tightly swollen from knee to ankle. There was moderate bruising behind the knee joint, which contained no fluid and movements of the knee and ankle joints were normal. The colour of the limb was good and the dorsalis pedis pulse was present. Patchy impairment of sensation over the dorsal surface of the left hallux and second toe was noted.

A diagnosis of traumatic thrombosis of the left popliteal vein was made.

Several hours later, selective tenseness of the tissues in the anterior fascial compartment of the left leg was noted, with loss of function of the extensor muscles here and definite loss of sensation over the cutaneous distribution of the left anterior tibial nerve. The dorsalis pedis pulse was readily palpable. The condition was considered to be due to tension in the anterior tibial compartment and subsequently, at operation, the deep fascia overlying this space was divided through a long incision. The muscles of the compartment were of ischaemic appearance, being a pale, "smoked salmon" colour and non-contractile.

The following day there was thought to be some recovery of the sensory loss. The dorsalis pedis and posterior tibial pulses remained present and were, in fact, better felt than on the normal side. No definite recovery of power in the extensor muscles of the anterior compartment occurred.

On the first and second post-operative days, a small haemoptysis had occurred, thought to be due to pulmonary embolus. On the sixth day after admission, and in spite of anticoagulant therapy, a sudden attack of retrosternal pain and breathlessness terminated in death. Unfortunately no post-mortem examination was made.

The preceding case would seem to illustrate the pathogenesis of the anterior tibial syndrome, in that acute oedema, the result of venous obstruction, produced ischaemia in the anterior tibial compartment. As sometimes described in the syndrome, the dorsalis pedis pulse remained palpable. No explanation is apparent for the increased pulse pressure noted at one stage.

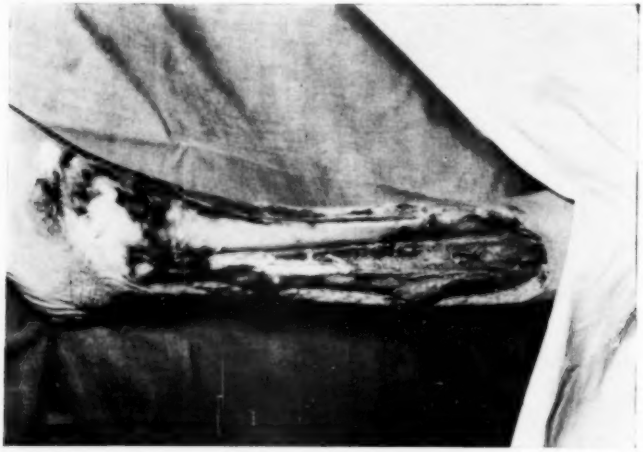

FIG. II. The skeletal appearance of the leg several days after surgical evacuation of the necrotic contents of the anterior tibial compartment. The remainder of the leg is discoloured but viable.

In the pathogenesis of the anterior tibial syndrome and in organic anterior tibial artery occlusion, several factors are cited. First is the paucity of major arterial anastomoses with the anterior tibial artery and its rather solitary nature in the supply of the anterior compartment (Hughes, 1948). Secondly, the anterior tibial compartment is a confined space in which any tissue swelling or oedema will produce a rise in tension, which will be inimical to the development of a collateral circulation. Hughes has suggested that such swelling may occur when the muscles within the space undergo degeneration from a mild degree of ischaemia, and thus perpetuate the condition; and that the rapid increase in muscle volume (up to 20 per cent.) which he

says may follow exercise may be the precipitating factor in the "anterior tibial syndrome".

Case 3 (A personal experience, kindly provided by Sir H. Simpson Newland)

About eighteen months before, and without any definite injury, the region of the right first tarso-metatarsal joint became swollen and tender on the dorsal and inner aspects.

There was little pain except on getting out of bed in the mornings, when weight bearing was painful and caused a limp. Gout as a diagnosis was considered and treatment with colchicine appeared to help, but discomfort and a clicking sensation persisted. The swelling on the dorsum of the foot extended upwards along the line of the tibialis anterior muscle to its upper limit. There was deep pitting and tenderness on pressure, and the swelling obscured the pulsation of the dorsalis pedis artery.

At the present time the pulsation of this artery is weaker than that of the other side, and the brawny oedema has subsided to reveal that the tibialis anterior muscle feels almost bony hard and almost non-contractile. Deep tenderness persists in the upper part of the leg. A slight foot-drop has been present almost from the first, but there are no sensory changes.

An X-ray taken at the commencement of illness showed no abnormality.

The aetiology in this case is not obvious, but the nature of its sequelae makes the diagnosis apparent. There seems to be no particular reason to relate the condition to age, to acute gout, or to the treatment with colchicine.

Diagnosis

The diagnosis of these conditions will be readily made either by familiarity, or by a consideration of the anatomical site of the ischaemic tissue. Under certain circumstances, however, confusion may arise with two conditions.

1. Trauma

Until the undeniable manifestations appear, the condition could be mistaken for a subfascial haematoma, particularly when the painful, tender, bluish red swelling over the muscle bellies is precipitated by exertion and the remainder of the leg shows little evidence of vascular occlusion to suggest the correct diagnosis. Even rupture of muscles might be suspected should foot-drop be present. Diagnosis will then depend on a careful history and examination aided by acquaintance with these vascular conditions.

2. Infection

It is well known that signs of inflammation may appear in the skin overlying ischaemic muscles. The painful swelling and colour change in this condition may, at first, simulate an inflammatory lesion like cellulitis or osteomyelitis, particularly when the degree of ischaemia is moderate and the ultimate tissue loss is small. Cases have been described where the indurated area has been incised, and the escaping liquefied necrotic tissue mistaken for pus.

Treatment

All the standard measures for the relief of pain, the reduction of oedema and the promotion of collateral circulation should be employed. Anticoagulants are used unless major surgery is contemplated shortly. In the anterior tibial syndrome, complete rest should be enforced until the condition subsides.

The surgical measure suggested by Carter, Richards and Zachary (1949) for cases of anterior tibial syndrome should be used in all cases seen at an early stage, when the fate of the threatened muscle tissue has not yet been decided. Through a small incision, the deep fascia over the anterior aspect of the leg is divided along the length of the anterior compartment in an attempt to relieve the tension which may exist in the space.

SUMMARY

The condition of occlusion of the anterior tibial artery is described and illustrated by a case of embolism resulting in gangrene of the tissues of the anterior compartment, infection and ultimately in amputation. The related condition of the anterior tibial syndrome is mentioned. The early recognition of the condition is necessary, to employ a minor surgical procedure which may offer some prospect of mitigating the effects of the ischaemia.

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THE AETIOLOGY, COURSE AND SURGICAL ASPECTS OF PANCREATITIS*

A REVIEW OF 108 CASES

By J. T. Boyer[1] and I. R. Mackay[2]

From the Clinical Research Unit of the Royal Melbourne Hospital and the Walter and Eliza Hall Institute of Medical Research, Melbourne

RECENT reviews, cited by Johnson and and Kalser (1959), have emphasized the many possible causes of pancreatitis and the value of surgical treatment of relapsing pancreatitis. Regardless of aetiology, surgeons reported 50-80 per cent. successes with a variety of operative procedures, including cholecystectomy, choledochotomy with removal of gall stones, sphincterotomy, distal pancreatectomy with pancreatico-jejunostomy, and cholodocho-jejunostomy. However, few attempts have been made to compare results of surgical treatment with the natural history of pancreatitis. This review of 108 consecutive cases of pancreatitis studied over thirteen years has provided a good picture of the possible causes and natural history of the disease, and of the prognosis in surgically and non-surgically treated patients.

Materials and Methods

Case material

The cases studied include all of 108 patients with established pancreatitis admitted to the Clinical Research Unit of the Royal Melbourne Hospital from 1946 to 1959; an equal number of possible cases of pancreatitis was not included owing to uncertainty of diagnosis. Fifty-three of these 108 cases were studied in an aetiological survey of pancreatitis by Joske (1955a). The diagnosis of pancreatitis was confirmed at laparotomy or post-mortem, or by an unequivocal elevation of urinary diastase or serum amylase during an illness clinically consistent with the diagnosis; in three exceptions steatorrhoea, diabetes, an abnormal secretin test and pancreatic calcification were deemed confirmatory. The pathological entities of haemorrhagic, interstitial, and fibrotic pancreatitis were not differentiated in this analysis. Follow-up was possible in 102 patients for a mean period of four and one half years from the onset of the illness.

The following classification of pancreatitis was employed.

(1) Acute pancreatitis.
A single acute attack with an abrupt onset, characteristically but not invariably painful (29 cases).

(2) Chronic relapsing pancreatitis.
With more than one painful attack—
(a) less than 10 attacks during the period of observation (47 cases);
(b) more than 10 attacks during the period of observation (26 cases).

(3) Chronic insidious (silent) pancreatitis.
An insidious development of a painless disease (6 cases).

This classification was designed primarily for the purpose of expressing quantitative differences in terms of the frequency of attacks, although in relapsing cases the attacks were often mild and did not require hospital care, and were estimated only from the patient's history; thus the severity of any one attack was not taken into consideration by this classification. The three subdivisions have no aetiological connotations, since the different causes of pancreatitis may each produce acute, relapsing or chronic silent disease.

Laboratory methods

Urinary diastase was estimated by a modification of the Wohlgemuth method (Maxwell, 1944), levels greater than 200 units per ml. were regarded as abnormal. Serum amylase was estimated by the method of King (1951); levels above 300 units per 100 ml. were considered abnormal. The secretin test was performed by the method of Dornberger *et alii* (1948); collections of duodenal fluid were

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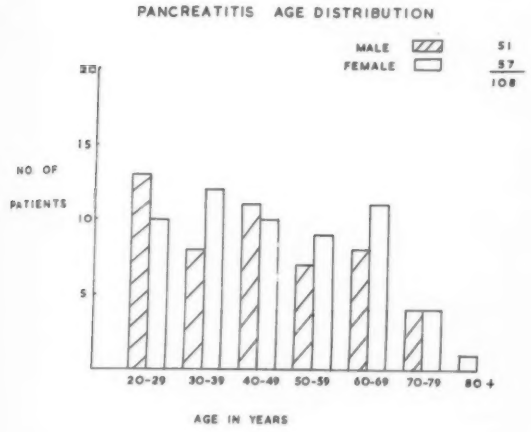

FIG. I. The age and sex distribution of 108 cases of pancreatitis.

made for 40 minutes after the intravenous injection of secretin (1 unit per kg. body weight).*

OBSERVATIONS

Case distribution according to age and sex (Fig. I)

There were 57 females and 51 males with an average age of 47 years for both sexes (range 19-83 years); 43 females and 30 males developed chronic relapsing pancreatitis. The even distribution by decade of both sexes was striking, as was the high incidence in the young.

Clinical features

The wide variety of presenting symptoms and signs made the diagnosis of pancreatitis difficult. The site of the pain was variable but was most commonly located in the upper abdomen, usually in the epigastrium. It varied from mild to intense, and from a steady boring to a cramp-like quality. In most cases pain radiated to the back or shoulder and there was associated vomiting. Fifteen patients had pain of a sufficiently bizarre nature to be called "atypical". In addition to the 6 chronic silent cases, 4 severely ill patients with acute pancreatitis had no pain whatever. The Grey Turner sign of skin discolouration in the loin was present in 2 cases. Fever, leucocytosis and an increased blood sedimentation rate were usually but not invariably present. The most common erroneous diagnosis were acute cholecystitis and perforated duodenal ulcer.

Conditions associated with pancreatitis (Table 1)

Gall-stones

Gall-stones were present in 43 per cent. of the patients and were the most commonly encountered of the suspected causes of pancreatitis (Fig. II and Table 2). This unusually high incidence parallels the finding that gall-stones are exceptionally common in the Australian population at large (Joske *et alii*, 1954). Of those with gall-stones, 82 per cent. developed relapsing pancreatitis, whereas none had chronic painless pancreatitis. The finding

TABLE 1

PREDISPOSING AND CO-EXISTING CONDITIONS IN 108 CASES OF PANCREATITIS

A. *Those of possible aetiological relevance*	
Condition	*No. of Cases*
Gall-stones	46
Alcoholism	24
Antecedent surgery — trauma	17
Vascular disease and ischaemia	17
Persistent hypertension (7 cases) Coronary artery disease (5 cases) Cerebral vascular disease (3 cases) Haemorrhagic shock (2 cases)	
Mumps	4
Preceding diabetes	2
Hydatid cyst of pancreas	1
Cystic fibrosis	1
B. *Co-existing conditions*	
Obesity	22
Duodenal ulcer	8
Pregnancy and parturition	5
Cancer (non-pancreatic)	5
Severe anxiety	5
Chronic hepatitis	4
Asthma	3
Polyarthritis (non-rheumatoid)	2
Pulmonary tuberculosis	2
Gout	2
Systemic lupus erythematosus	1
Encephalopathy	1

*Supplies of secretin were generously provided by Eli Lilly and Company.

at laparotomy of gall-stones in the common bile duct or a dilated bile duct in only 6 patients does not support the concept of pancreatitis being the result of calculous obstruction of the terminal bile duct.

Whereas gall-stones predominated in the older age groups with pancreatitis, being a probable reflection of the increasing incidence of gall-stones in the population with age, alcoholism predominated in younger patients

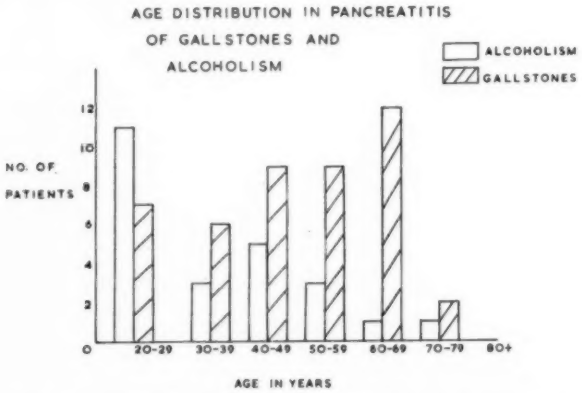

FIG. II. With increasing age, there is an increasing co-existence of gall-stones and a decreasing incidence of alcoholism.

Alcoholism

Twenty males and 4 females were frank alcoholics as judged by their own ready admission, by interview with their families, or by subsequent observation during long acquaintance in a follow-up clinic (Table 3). Fifty-four claimed abstinence or drank alcohol rarely, 15 described themselves as "moderate drinkers" and 15 were inadequately recorded. Gall-stones coexisted with alcoholism in only 4 cases. Of the 24 alcoholics, 85 per cent. had relapses, and relapses were often related to alcoholic drinking bouts. However, neither gall-stones nor alcoholism were associated with more frequent relapses or more complications in general than occurred in the total series.

(Fig. II). This age distribution represented a good correlation with the observation that alcoholics begin their heavy drinking in early adult life (Wood, 1959), and illustrates the much shorter "incubation time" of alcoholic pancreatitis as compared with alcoholic liver disease (Table 4).

Of 4 patients with pancreatitis associated with chronic hepatitis, 3 were alcoholics and in these it seems likely that the hepatic and pancreatic disease both resulted from long-standing malnutrition.

One alcoholic patient, during a severe attack of pancreatitis, suffered from prolonged disorientation and confusion; this encephalopathy, which was unlike delirium tremens, may have been a sequel of pancreatic necrosis.

TABLE 2

INCIDENCE AND SEX DISTRIBUTION OF GALL-STONES IN PANCREATITIS

Type of pancreatitis	*Gall-stones present*		*Gall-stones absent*		*No information*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*
Acute pancreatitis	3	5	9	3	4	5
Relapsing pancreatitis						
(a) infrequent attacks	10	13	9	11	1	3
(b) frequent attacks	5	10	5	5	0	1
Chronic insidious pancreatitis	0	0	1	2	3	0
Totals	18	28	24	21	8	9

TABLE 3

ALCOHOLISM: CASE DISTRIBUTION FOR CATEGORIES OF PANCREATITIS

Type of pancreatitis	*Alcoholics*	*"Moderate drinkers"*	*Abstainers*	*No information*
Acute	5	7	11	5
Relapsing—				
(a) infrequent attacks	12	7	19	9
(b) frequent attacks	6	1	19	1
Chronic insidious	1	0	5	0
Totals	24	15	54	15

Antecedent surgery

Surgery preceded the development of pancreatitis in 17 patients (16 per cent.). The surgical procedures were cholecystectomy in 14 cases with exploration of the common bile duct in 4, gastrectomy in 2 and laparotomy in one case. A severe fatal post-operative pancreatitis complicated choledochotomy in one case, the dissection of a posterior perforating ulcer from the pancreas in 2 cases, and a laparotomy with a liver biopsy in one case.

However, this association of pancreatitis with preceding surgery was not necessarily indicative of surgical trauma being the cause of the pancreatitis, for in 12 of the 14 cases subjected to previous biliary surgery the diagnosis was only made months to years after the time of surgery; such patients were usually diagnosed as "post-cholecystectomy syndrome" before pancreatitis was recognized. Thus it was impossible to determine which of these cases were the result of pancreatic trauma during the operation, and which were cases wherein an unnecessary gall bladder operation was performed for misdiagnosed and pre-existing relapsing pancreatitis. As the common bile duct was explored in only 4 of these 14 cases, an undetected stone could have been the cause of pancreatitis in some of them.

Hypertension and vascular disease

Elevation of blood pressure was found on initial examination in 30 patients and was presumably a manifestation of pain, for it persisted in only 7. Coronary artery disease was present in 5 cases, and cerebral vascular disease in 3. These 8 cases, together with those 7 in whom hypertension persisted, would appear to represent a significant incidence of vascular disease with pancreatitis, as suggested by Heinz (1952) and Joske (1955b). However, of the 15 patients in whom these vascular abnormalities occurred, 8 also had gall-stones and one was an alcoholic, and there were only 3 cases in whom vascular disease was the sole suspected aetiology. There

TABLE 4

RELATIONSHIP OF ALCOHOLISM, ALCOHOLIC LIVER DISEASE, AND ALCOHOLIC PANCREATITIS TO AGE

	Per cent incidence by age		
	Under 30	30–50	*Over* 50
Onset of heavy drinking	79	14	7
Admitted to hospital with alcoholic liver disease	7	52	41
Admitted to hospital with alcoholic pancreatitis	46	37	17

were 2 cases in which pancreatitis followed acute haemorrhagic shock; these might also be regarded as having an ischaemic basis.

Parturition

Post-partum pancreatitis has been previously reported by Langmade and Edmundson (1951) and from our Unit by Joske (1955a); it was exemplified in 6 patients in this series, 3 of whom also had gall-stones. However, since the incidence of women in the child-bearing age was relatively high in this series (22 out of the 57 women were less than 40 years of age), the association between parturition and pancreatitis may not be causal.

Duodenal ulcer

This was present in 8 patients. In 2 patients pancreatitis first developed after surgical dissection of a posterior penetrating ulcer from the pancreas. Of the remaining 6 patients, 3 were alcoholics and 3 had gall-stones.

Polyarthritis and prednisone therapy

Relapsing pancreatitis was associated with intermittent polyarthritis in 3 young women, one of whom had systemic lupus erythematosus. In 2 patients with polyarthritis, attacks of pancreatitis were precipitated by prednisone; this complication of steroid treatment has been observed clinically, at post-mortem and experimentally (Johnson and Kalser, 1959).

Miscellaneous conditions

Obesity was recorded in one-fifth of the patients, but this association was not analysed further. Pancreatitis complicated mumps in 2 cases, prednisone therapy in 2 cases, and was associated with a hydatid cyst of the pancreas in one case, and with cystic fibrosis of the pancreas in one case reported by Marks and Anderson (1960). Diabetes pre-existed in only 2 of the 108 cases, which is approximately the incidence of diabetes in the general population. A severe anxiety neurosis was present in 5 patients and there was a clear relation between attacks of pancreatitis and emotional stress in this group. Non-pancreatic cancer occurred in 5 cases whilst under observation, asthma in 3 and tuberculosis in 2; in 2 cases, classical gouty attacks were repeatedly precipitated by episodes of relapsing pancreatitis.

LABORATORY FINDINGS

The urinary diastase test was the best for confirming the diagnosis, being significantly elevated in 80 per cent. The serum amylase was elevated in 12 of 19 cases tested, including 3 cases where the urinary diastase was normal, so that its estimation was of some additional value.

TABLE 5

LABORATORY STUDIES IN 108 CASES OF PANCREATITIS: CASE DISTRIBUTION

	Abnormal	*Normal*	*No information*
Urinary diastase	73	18	17
Serum amylase	12	7	89
Serum bilirubin	29	35	44*
Serum alkaline phosphatase	33	39	36
Serum lipids	24	30	54
Glucose tolerance test	27	31	50

*Probably normal.

The high incidence of jaundice (serum bilirubin greater than 2 mg. per 100 ml.) is noteworthy, being present in 29 cases. Jaundice was twice as common in those with gall-stones as those without, and was five times as common in those with gall-stones as in alcoholics. Only 55 per cent. of patients who became jaundiced relapsed, whereas 76 per cent. of non-jaundiced patients relapsed. Jaundice during the *initial* hospitalization was associated with a significantly higher remission rate than was lack of jaundice. The serum alkaline phosphatase level was elevated in 33 of 72 patients in whom it was measured, and in general followed the same case distribution as jaundice.

Hyperlipaemia of mild to severe degree was present, at least transiently, in 24 of 54 cases in which determinations were made; in most cases hyperlipaemia appeared to be the result, rather than the cause, of pancreatic necrosis: this is in agreement with the experimental findings of Wang *et alii* (1958), and the clinical experience of Albrink and Klatskin

(1957) and Wang *et alii* (1959). However, attacks of pancreatitis may complicate essential hyperlipaemia (Joske, 1955b), possibly being the result of pancreatic embolism by fat particles.

The glucose tolerance test was mildly to grossly abnormal in 27 of 58 patients tested, but was of no prognostic significance in terms either of future relapses of pancreatitis or of the subsequent development of diabetes.

Gastric function

This was assessed by histamine stimulation and suction biopsy. Gastric structure and function were normal in most (14 out of 17) cases tested of acute non-relapsing pancreatitis. In chronic relapsing pancreatitis, 13 out of 51 cases tested gave abnormal findings. Achlorhydria was present in 9 cases and there was biopsy evidence of chronic gastritis with atrophy in 9 cases; both achlorhydria and gastritis were present in 5 cases. No consistent aetiological factor, including alcoholism, was found to account for this possible association between gastritis and relapsing pancreatitis.

Secretin test

After duodenal intubation and injection of secretin, measurements were made of total volume, maximal bicarbonate concentration (mEq./L) and total bicarbonate (mEq.) of the pancreatic secretions over 40 minutes; the lower limits (mean — 2 S.D.) for each of these estimations were taken as 50 ml., 7.0 mEq. and 0.05 mEq./L (Dornberger *et alii* 1948; Dreiling, 1955). A test was regarded as equivocal if any two, and abnormal if all three, of the above estimations were below these limits. Twenty-five cases of relapsing pancreatitis were tested; the result was normal in 9 cases, equivocal in 6 cases and abnormal in 10 cases, representing an even distribution of cases from a normal to an abnormal response. All 4 cases of chronic insidious pancreatitis showed an abnormal test.

Considerable care and experience are needed in the performance of secretin tests and faulty collections must be excluded as an explanation of a low secretory response. A normal result clearly does not exclude moderate degrees of pancreatic damage. However, an abnormal result in a validly performed test is significant and suggests either relapsing pancreatitis with advanced fibrosis, chronic insidious pancreatitis or pancreatic cancer.

HISTOLOGICAL FINDINGS

The pancreas was examined macroscopically in 59 (45 at laparotomy and 14 at necropsy) of the 108 cases. Histological material was obtained in 37 instances, including 24 biopsies obtained at laparotomy — these 24 biopsies comprise part of a series of 48 operative biopsies taken to assess the diagnostic value of this procedure; untoward sequelae of biopsy were pancreatitis in one case and a fistula in one case.

The histological findings (biopsy and necropsy) in 10 cases of acute and 27 cases of relapsing pancreatitis varied widely, the case distribution being as follows: normal acini (7), interstitial inflammation (2), haemorrhagic pancreatitis (3), necrosis or abscess (5), acute inflammation and fibrosis (3), fat replacement (3), mild fibrosis (2), moderate interlobular fibrosis (2) and dense fibrosis (10).

It is of interest that at 7 of the laparotomies on cases of clinically established relapsing pancreatitis, "histologically normal" tissue samples were obtained although there was fat necrosis elsewhere in the abdomen. Thus, relapsing disease is consistent with the preservation of normal architecture, at least in some areas of the pancreas. Such histological "recovery" is of interest in consideration of the recovery of relapsing pancreatitis mentioned below.

PROGNOSIS AND RESULTS OF TREATMENT

Assessment of remission

Recurrence rates in relapsing pancreatitis were calculated by dividing the total number of attacks by the time interval between the first and last known attacks. By this analysis, only 3 patients had recurrence rates of less than one per year and no patient had attacks less often than once in two years. Thus, a patient could be considered "cured" if two years had passed without relapse. Conversely, a patient was considered "not cured" if he had been observed two years or longer and was still having attacks. Fifty-five of the 73 relapsing cases have been followed long enough to be classified as "cured" or "not cured". Of these 55, 24 have had remissions while 31 remain chronically relapsing; this represents an overall remission ("cure") rate of 44 per cent. If the 15 cases who were treated by biliary surgery are excluded, 35 per cent. of the remaining 42 non-surgically treated relapsing cases went into remission.

Surgical treatment

Thirteen of 16 surgically treated patients with relapsing pancreatitis had gall-stones and were treated by cholecystectomy, and in 2 patients by additional sphincterotomy; none of these 13 had stones in the common bile duct or evidence of biliary obstruction. A two-year remission was obtained in 8 patients, whilst 5 continued to have attacks; this remission rate of 61 per cent. was better than the overall rate of 44 per cent. However, an additional 14 cases not included in the above analysis of surgical results had antecedent surgery for gall-stones before the diagnosis of relapsing pancreatitis was made; some of these "post-surgery" cases may have had unrecognized relapsing pancreatitis prior to surgery and were obviously not helped by operation. Inclusion of these would bring the remission rate for surgically treated cases below 50 per cent.

TABLE 6

RELATION OF THE DEVELOPMENT OF DIABETES TO THE CLASSIFICATION OF PANCREATITIS

Type of pancreatitis	*No. of cases*	*Diabetes*	
		No.	*% incidence*
Acute	29	2	7
Relapsing:			
Infrequent attacks	47	6	13
Frequent attacks	26	5	19
Chronic insidious	6	3	50
Total	108	16	15

Three patients who did not have gall-stones were treated surgically; two had a sphincterotomy with subsequent remission, but in both alcoholic intake was curtailed post-operatively. The third had splanchnic sympathectomy with only temporary benefit. One patient with proven gall-stones but no surgical treatment has had a definite remission of greater than two years.

Late sequelae

Pancreatic cyst, pseudocyst, or fistula occurred in 9 cases but had no bearing on the outcome of the individual case. Steatorrhoea occurred in 9 patients, 5 being in the group with chronic silent pancreatitis. Diabetes mellitus developed subsequent to pancreatitis in 16 patients, including 3 with a family history of diabetes; some were mild and controlled by diet but the majority required insulin. A direct correlation was observed between the incidence of diabetes and the number of attacks of relapsing pancreatitis (Table 6).

Mortality

Eighteen patients died during the course of this study. In 10, death was directly attributable to pancreatitis, 5 deaths occurring during the initial acute attack. There were no deaths from pancreatitis under the age of 40, although 40 per cent. of the patients were below that age.

CONCLUSIONS

This study of 108 cases of pancreatitis has delineated conditions which were clearly associated with the onset and natural history of pancreatitis, although the aetiological relevance of such conditions remained uncertain. Some cases could be assigned to a recognized cause such as virus infection (mumps), trauma and infarction, but in many cases the exact pathogenesis was doubtful. As in most European and American surveys, gall-bladder disease and alcoholism were by far the commonest associated conditions.

There is sound clinical and experimental evidence linking alcoholic pancreatitis with malnutrition and protein deficiency although this concept does not explain how alcohol often "triggers" an attack of pancreatitis. The rôle of gall-stones is more debatable Sphincteric obstruction with reflux of bile via the "common channel" was not of significance in this series; moreover, cholecystectomy did not always improve the course of relapsing pancreatitis. The alternative suggestion is that gall-stones and relapsing pancreatitis are both determined by a common underlying metabolic error, conceivably related to lipid transport by the blood. Ischaemia has been cited in the pathogenesis of relapsing pancreatitis; however, younger patients with pancreatitis usually show little collateral evidence of arterial occlusive disease.

Over 70 per cent. of cases in this series had recurrences, emphasizing that pancreatitis is inherently a relapsing disease. The natural history of pancreatitis may be marked by remission and probably "cure", continued relapses, complications of the disease or death. Remission had already occurred in 44 per cent. of the relapsing cases in this series

and in 35 per cent. of these treated medically others may be expected either to remit or to experience milder attacks. Thus, the natural history of the relapsing disease may tend towards recovery under a conservative regime. This tendency makes it difficult to evaluate surgical manoeuvres such as sphincterotomy, especially as surgical treatment is frequently accompanied by injunctions against alcoholic and dietetic excesses (Doubilet and Mulholland, 1956). In our series, the remission rate after cholecystectomy was only moderately better than that of medically treated cases.

The major complication of pancreatitis was diabetes mellitus, which supervened in 16 patients; its incidence was directly related to the number of attacks the individual experienced. Steatorrhoea due to pancreatic insufficiency was uncommon, except in chronic silent pancreatitis. Jaundice and hyperlipaemia occurred during or shortly after attacks but were usually transient. Attacks of gout were directly related to relapses in 2 cases. Eighteen patients died during the study but only 10 of these deaths were directly attributable to pancreatitis. The 10 deaths all occurred in patients over 40, the elderly being, as would be expected, more vulnerable to acute attacks of the disease.

The further understanding of pancreatitis demands that efforts be made to determine the aetiology in every case and the precipitating cause of each attack. Secondly, the value of surgery, which appears to be limited in the overall treatment of pancreatitis, should be carefully assessed in the light of the natural history of the disease.

SUMMARY

1. A consecutive series of 108 cases of pancreatitis comprised 29 patients who had a single acute attack, 73 who developed chronic relapsing pancreatitis, and 6 who presented with chronic "silent" pancreatitis.
2. Gall-stones in 46 patients and alcoholism in 24 patients were common associated conditions. Trauma, vascular disease and viral infection were true aetiological factors in some cases.
3. Laboratory studies disclosed jaundice in 29 cases, hyperlipaemia in 24 cases, disturbed glucose tolerance in 27 cases and an abnormal secretin test in 14 cases.
4. Surgical biopsies in relapsing pancreatitis showed a wide variety of histological appearances.
5. Ten deaths resulted from pancreatitis. Frank diabetes occurred in 16 patients and was directly related to the frequency of attacks of pancreatitis. Pancreatic insufficiency with steatorrhoea was rare except in chronic insidious pancreatitis.
6. In relapsing pancreatitis, remissions of two or more years eventually occurred in 44 per cent. of all cases, and in 36 per cent. of those who were not treated surgically. It is suggested that results of surgical treatment in pancreatitis be evaluated in terms of the expected cure rate in patients not receiving surgery.

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Books Reviewed

TEXTBOOK OF BRITISH SURGERY.

Edited by Sir HENRY SOUTTAR and Professor J. C. GOLIGHER. Vol. IV. London: Wm. Heinemann Medical Books Ltd., 1959. 10" x 7¼", viii plus 699 pp., 405 figures. Price: £5 5s. (stg.).

This is the fourth and final volume of the *Textbook of British Surgery* edited by Sir Henry Souttar and Professor Goligher. In this section which deals with orthopaedic surgery, they have had the assistance of Mr. Norman Capener. There are a number of eminent authors who have contributed to this volume, which is a fairly large one. Section I deals with "Inflammation and Pyogenic Infections," by Ian Gordon, of considerable length. Then there is a section on "Acute Fractures and Dislocations," by John M. P. Clark, which is very up-to-date except that not too many experienced surgeons will agree that non-union of the proximal pole of the navicular will react best to excision. The useful method of transfixing by Kirschner wires the two fragments in a difficult fracture dislocation of the Bennett's type is described. The section on general orthopaedics has been written by the editor and is excellent in every way. There are a number of illustrations showing the various operations on the hip joint which should be helpful, including the Pauwell-Blundell Jones operation for coxa valga in paralytic dislocations. The section on tumours of bone is in keeping with the modern view on diagnosis and treatment. For example, the section on osteoclastoma or so-called giant cell tumours which are so treacherous in their behaviour and therefore cause such anxiety on the part of the surgeon who has to deal with the problem, it is interesting to note the return of the old method of using a caustic-like zinc chloride solution to the walls of the cavity after curettage. Surgery of the hip joint is dealt with by E. N. Wardle and starts off with the treatment of the congenital dislocation of the hip. The limbus, originally described by the French workers to which attention was again directed by Somerville in 1953, is discussed. On the whole, the book is an up-to-date modern textbook of orthopaedic surgery written by a number of experienced British orthopaedic surgeons. It may be regarded as a representation of British orthopaedic present-day teaching and practice.

TRANSPLANTATION OF TISSUES, Volume 2.

Edited by LYNDON A. PEER, M.D. London: Bailliere, Tindall & Cox, 1959. 10¼" x 7", xiii plus 690 pp., 252 figures. Price: £8 (stg.).

No branch of surgical research is receiving more attention at the present time in all parts of the world than tissue transplantation. It must be difficult enough for the research worker himself to keep abreast of the current work on the subject in all its ramifications, and the task of the practising surgeon in trying to apply this increasing fund of knowledge would be wellnigh impossible without assistance from periodic publications of this kind.

This book is the second of two large volumes which give a remarkably broad, lucid and detailed cover of the subject. The first volume, as well as dealing widely with the basic principles involved, covered the supporting structures of the body, and now the second volume completes the picture with sections on skin, cornea, fat, nerves, teeth, blood vessels, endocrine glands, organs, peritoneum and cancer cells. This latest work, however, is complete in itself for much of the background of principle is repeated in order to give a clear overall picture to the reader. The complete bibliography that is provided will be of the greatest value to workers in the field and to surgeons seeking further information on special subjects.

Taken together, these two volumes can now be said to provide all that is required for an up-to-date knowledge of this vast subject. The individual sections have been written by recognized authorities in their field and the whole standard of the publication is of the highest quality.

TREATMENT OF CANCER IN CLINICAL PRACTICE.

Edited by P. B. KUNKLER and A. J. H. RAINS. Edinburgh and London: E. & S. Livingstone Ltd., 1959. 10" x 7", 821 pp., 372 figures, 72 tables. Price: £5 (stg.).

This is a large volume of 821 pages by British authors. It is designed to present a comprehensive picture of the methods available for the treatment of neoplastic disease, particularly the radiotherapeutic and surgical disciplines. Most chapters have been written jointly by a surgeon and a radiotherapist, and this in itself justifies the publication of yet another volume on cancer therapy. It is not a text to which either the surgeon or radiotherapist would refer for details of a specialist procedure. However, the material presented is sufficiently detailed to provide the clinician with a very clear picture of what the various specialties have to offer, and indeed the book has been designed primarily in "the interests of men and women preparing for post-graduate examinations such as the F.R.C.S., M.R.C.O.G. and F.F.R." It attempts to "supplement and not to replace the standard works on operative surgery and radiotherapy" and emphasizes problems directly concerned with treatment, rather than clinical and diagnostic aspects.

The initial 8 chapters are of an introductory nature, dealing with historical aspects, principles relating to treatment by radiotherapy and surgery, chemotherapy, hormonal control and the presentation of results of treatment. The remaining 32 are topographical.

On the whole most chapters give an admirable presentation of the subject. Perhaps the least acceptable are the chapters dealing with tumours of bones and connective tissues, which lack clarity and decision. On the other hand the chapters dealing with the eye and orbit, the middle ear cleft and upper respiratory tract are admirably written. The recommendation of the McWhirter technique, as a treatment of choice for breast cancer, will not find favour with all surgeons (and radiotherapists). The radical operation has been dismissed in less than a

page! Again the staging of breast cancer suggested — that agreed upon by the Association of Surgeons and the Faculty of Radiologists and awaiting international acceptance — is by no means universally acceptable.

On the radiotherapeutic side, the physical aspect has been excellently presented in a separate chapter. However, the radio-biological side of the question fails to afford satisfaction. In particular, insufficient insight has been accorded the phenomena of radiosensitivity and radioresistance. For example, reticulosarcoma is adjudged a tumour of high species radiosensitivity and high local radiocurability, whilst Hodgkins disease and giant follicular lymphoma are represented as less radiosensitive. In the experience of most radiotherapists, reticulum cell sarcoma may have considerable radioresistance. The various biological factors which govern tumour radiosensitivities have been insufficiently emphasized.

Also a potential source of confusion is the failure to clearly state the rationale for combined radiosurgical techniques. To many thinking surgeons and radiotherapists, it seems difficult to justify the employment *electively* of two *radical* techniques — radiation ablation and complete surgical extirpation — for a single local condition. A dual attack tends to result in the error of limited ablation, to "let the other fellow cope with any remaining disease." Furthermore, the one discipline often interferes with the proper execution of the other which is to follow.

However, despite these reservations, this volume affords pleasant and profitable reading, education in the other's speciality and most definitely merits a place in the clinician's library as a reference volume in cancer treatment.

METABOLIC CARE OF THE SURGICAL PATIENT.

By FRANCIS D. MOORE. Philadelphia, U.S.A.: W. B. Saunders Co., 1959. 11" x 8", 1,011 pp., 143 figures. Price: £10 (Aust.).

The task of the reviewer is a formidable one when he is confronted by a scientific text of 1,000 pages. Under such circumstances he can reasonably be allowed to be honest, and, while claiming that he has read enough to do justice to the text, to admit he has not been through it carefully from cover to cover. Such then must be our confession, for this is a monumental volume.

Francis Moore was appointed to the Chair of Surgery in the Peter Bent Brigham as a very young man and he has since established a tremendous reputation by his painstaking studies of the disordered metabolism in surgical patients. Readers of his earlier work written in collaboration with Dr. M. R. Ball, will not expect to find this volume susceptible to easy and quick digestion. We have found (and we will be surprised if this is not also true of the generality of surgeons) much of it is exceedingly difficult to read and often even to understand: not that much of what Professor Moore has written is not simple and fundamental, but it is dealt with in a critical and penetrating way reminiscent of the writings of Thomas Lewis and inspired no doubt by his mentor, E. D. Churchill.

This is a contribution which throughout has the hallmark of authority, for the argument is illustrated and sustained by diagrams (and Gamblegrams) and by a wealth of factual data faithfully and fully recorded from his own experience. The book is big and unwieldy; even the chapters and sectional headings are elaborate and involved, but the coverage is immense and detailed. Every aspect of deranged metabolism is covered including disorders of the heart and lungs, pancreas and burns and shock and a host of others. The net result is that one can hope to enjoy in these pages, when confronted by almost any problem in surgical management which relates to the patient's general metabolism, a private consultation with Dr. Moore, and to whom better could we wish to bring our difficulties. For here is a surgeon who is philosopher as well as scientist and who is almost tiresome in his insistence that any surgeon looking after a patient must be totally responsible for his care (surgery he calls the "specialty of getting well"). He declares (with such conviction that it must be for him a tenet of his faith) "the surgeon, not his consultants, joins the two in his own right: clinical judgement and a nice balance between operative skill and metabolic wisdom are needed; metabolic care is a part of surgery, not a separate consideration."

What nicer compliment can be paid the writer of this classic than to affirm most warmly that he has, in this volume, made the wisdom of this view fully apparent.

GOWLAND AND CAIRNEY'S NOTES ON ANATOMY. Volume 3.

Edited by W. E. ADAMS, A. R. ELLIS, G. C. SCHOFIELD, W. D. TROTTER and W. R. MORRIS. Second Edition. Christchurch, N.Z.: N. M. Peryer Ltd., 1959. 8½" x 5½", xvi plus 475 pp., no illustrations. Price: 57s. 6d. (N.Z.).

This book is intended to guide the medical student during his introduction to anatomy. In some respects it achieves this aim, for it contains excellent instructions for dissection, in addition to a clear concise descriptive text. Illustrations have been omitted because "many excellent and convenient atlases are now available." While this is no doubt true, there is much benefit in incorporating illustrations in a text and this is particularly true in an introductory text. This lack would make it difficult for a newcomer to the subject to comprehend the text, particularly if the atlas chosen by the student used a different terminology.

The text itself is, on the whole, clearly written, with a pleasing union of functional analysis with purely descriptive anatomy. Occasionally, however, in order to be concise some accuracy has been sacrificed, e.g. in the description of the development of body from three germ layers. No errors have been noted in the text which is sufficiently full for the undergraduate student. The retention of much eponymous nomenclature (e.g. Hey's ligament, ligament of Lisfranc, ligament of Chopart, tubercle of Gerdy) at a time when most anatomists are making nomenclature accurately descriptive, seems to the reviewer to be unfortunate.

The book is well bound and produced, but since it is intended for use during dissection a washable plastic cover should have been provided.

TEXTBOOK OF SURGERY.

By PATRICK KIELY, M.D., F.R.C.S. Second Edition. London: H. K. Lewis Co. Ltd., 1958. 10" x 6½", x plus 1,158 pp., 610 illustrations and 22 coloured plates. Price: 63s. (stg.).

The advent of a new textbook of surgery arouses interest, particularly in academic circles. Surgeons who teach express admiration of the author's enthusiasm and endeavour in the completion of such a Herculean task, and will then be anxious to find out the plan of presentation. If a new volume is to take the place of some of the well-known classics in popular esteem, it should be expected to present the subject in some improved manner.

It would appear that Kiely has sought to do this by reducing references to surgical pathology and giving more coverage to actual treatment and management. The volume also includes moderately lengthy sections on diseases of the ear, nose, throat and eye — these sections may be justified on merit but their inclusion is considered to be a doubtful asset.

In compiling a textbook of surgery, some degree of stability is essential, otherwise it is out of date before the ink is dry — accordingly the author must be most careful, particularly in therapy, to be judicial in his presentation of methods. Surgical fashions are often notoriously transient and an author may undermine the value of his work by the dogmatic advocacy of a method of treatment which soon loses favour. It is felt that Kiely has made this mistake, as in his advocacy of radical partial gastrectomy for duodenal ulcer, failing to mention the Billroth 1 operation, and stating that there is now no place for gastro-enterostomy for gastric ulcer.

In the earlier chapters, one gets the impression that too much has been crowded into too little space and this would make this important section difficult for students and younger graduates.

There are quite a few points and opinions with which many would disagree. Few surgeons now use biniodide of mercury on their hands and Dupuytren's classification of burns has lost most of its usefulness. In the management of snake bite, surely the first thing to try to do is to ascertain if it was a venomous snake by examining the bite and, perhaps understandingly enough, the remarks on the management of hydatid disease would not gain approval in this land.

Again the management of carcinoma of the lip, few surgeons would now do the wide block dissection of glands, nor would they favour simple mastectomy for the small duct papilloma as described by Wakeley.

The general work of the publishers is very commendable and the illustrations are numerous. A few spelling errors have escaped the eye of the editor, and in a book of this nature, "do not" looks better in print than the colloquial "dont."

The overall impression is that this volume calls for the tolerant understanding of a surgeon who has undertaken a task most would avoid, remembering that it is much simpler and less risky to bring out a new and revised edition of an established textbook than to create a new one. It will be an interesting addition to a surgical library, but is not likely to supplant any of the standard books favoured by students in Australia.

AUTOGENOUS VEIN GRAFTS AND RELATED ASPECTS OF PERIPHERAL ARTERIAL DISEASE.

By W. A. DALE. Blackwell Scientific Publications, 1959. 9" x 6", 123 pp., 31 figures. Price: 48s. (stg.).

In these days of accumulating experience with restoration of continuity of arterial blood flows for obstructive disease, there are bound to be many advocates, in the light of their experience, of the various types of vehicle employed.

Where blood flow is maximal in the abdominal aorta and large abdominal branches, it appears that there is little to choose between artificial prostheses and frozen or otherwise preserved arterial homografts. There still remains for debate the indication for operation.

In the limb, the recognition of the common pattern and the natural history of the occlusion, has led to the adoption of long bypass grafts from the common femoral artery to the popliteal artery, irrespective of how locally segmental the occlusion may be in the adductor canal. This is not to say that all occlusions, local or otherwise, require operation — this will depend upon the degree of ischaemia in the limb and the general condition of the patient.

The clinical problem is a very common one, and the necessity for these long grafts has posed the very real problem of the availability of donor material. Increasing experience has shown that the plastic prostheses have many late shortcomings, but this has been accepted as inevitable in view of the numerical problems. There is therefore a strong case to be made for the use of venous autografts, which, other considerations aside, have the immense advantage of ready availability, possess no antigenic properties, and survive as living material.

There has been the bogey of aneurysm formation, probably overstated.

The author, in this well presented little volume, covers familiar ground in the consideration of the clinical manifestations of ischaemia in the limb, the problem involved, and the discussion on the facets of the investigation techniques common to all clinical presentations when graft is contemplated. A critical review of the results of use of the various replacement media is included. It is most commendably unbiassed .

The details of technique for the use of venous autografting (bypass) are elaborated in detail. Fortunately the surface anatomy of the long saphenous vein is almost that of the artery which it is intended to bypass. Results are reviewed and a convincing case is made for the employment of venous bypass autografting in the limb. Nothing new is added, but the further evidence of the reviewed series, the careful exposition of a studied technique involving the use of a physiologically acceptable, readily available, and apparently successful medium are a most useful contribution to our knowledge of replacement arterial surgery.

This book should be studied by all interested in the problem of arterial surgery in the limbs.